US Army Corps of Engineers®
Vicksburg District

Flood Control, Pearl River Basin, Mississippi

PEARL RIVER WATERSHED, MISSISSIPPI

Feasibility Study

Appendix 5 - Real Estate Plans
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Volume IV

PRELIMINARY

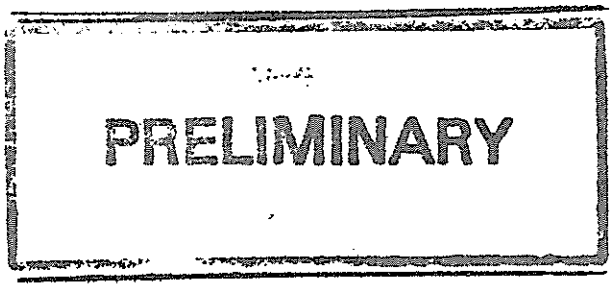
DRAFT

Not for Public Release

February 2007

APPENDIX 5

REAL ESTATE PLANS
COMPREHENSIVE LEVEE PLAN
LEFLEUR LAKES PLAN



Not For Public Release

REAL ESTATE PLAN
PEARL RIVER WATERSHED, MISSISSIPPI
HINDS AND RANKIN COUNTIES, MISSISSIPPI
LEVEE PLAN

I. PURPOSE OF REAL ESTATE PLAN

1.0. The purpose of this Real Estate Plan (REP) is to update the real estate requirements of the prior REP (approved 12 October 1995) in support of the 1996 draft, Jackson Metropolitan Area, Mississippi, Feasibility Report. The information contained within this report is based on the recommended plan in the previously mentioned draft report and other commercial, residential, industrial, zoning and estimated cost information presently available and is subject to change even after approval of this REP.

1.1. The project area is located in central Mississippi south of the Ross Barnett Reservoir, both sides of the Pearl River and north of Elton Road in the City of Jackson and north of Cleary Road in the town of Richland and being in Hinds and Rankin counties, Mississippi. Area municipalities include Jackson, Flowood, Pearl and Richland.

1.2. The purpose of this project is to reduce damages to existing development from headwater flooding, caused by infrequent heavy rainfalls over the upper Pearl River basin. This project includes construction approximately 21.9 miles of a new levee, 3,720 feet of floodwall, enlarging and raising 10.5 miles of the existing Jackson and East Jackson levees, building 9 box culverts and 9 concrete pipe water control structures, constructing landside connecting ditches and limited over bank clearing.

II. DESCRIPTION OF LERRD (Lands, Easements & Rights of Ways, Relocations, and Disposal Areas)

There will be approximately 328 tracts involving 248 owners within the proposed project right-of-way. The total acreage required for this project is approximately 2,780.33 acres; however, approximately 216.82 acres are previously encumbered by an estate equal to that which is proposed for the levees by the sponsor and 3.04 acres are encumbered with an estate greater than the clearing and snagging easement required by another sponsor, reducing the Lands, Easements, Right-of-way, Relocations and Disposal areas (LERRD) acreage to be acquired to 2,560.47 acres, more or less. Of the approximate acreage to be acquired: 233.84 acres will be for Clearing and Snagging Easements along the Pearl River,

1,073.32 acres will be for Perpetual Levee and Borrow Easements with 8.30 acres of this being for uneconomic remnants/severed areas. Of the preliminary right-of-way (ROW) acres identified on present mapping, no separation between levee and borrow acres has been made at this time. Borrow areas are presently located on the riverside adjacent to the existing and proposed levees, however, in the event material from these sites proves to be unsuitable, then satellite pits will be acquired to provide satisfactory materials. The remaining acreage will be Fee and includes 25.31 acres of commercial land due to induced flooding and 1228.0 acres for mitigation purposes to offset environmental impacts. This proposed project will be divided into 10 separate contracts. The total estimated market value for the LERRD to be acquired is $54,000,000 inclusive of contingencies, as shown in Exhibit I.

Estates	Acres
Fee	25.31
Perpetual Levee and Borrow Easements	1,073.32
Clearing and Snagging Easements	233.84
Total ROW Acres	1,332.47
Fee (for mitigation purposes)	1,228.00
Total Project Acres	2,560.47

Land Use	
Woods	974.65
Open	254.12
Water	26.19
Road	3.90
Railroad	1.51
Residential	23.52
Commercial	38.93
Industrial	9.65
Total	1,332.47

Land Zoning	
Agricultural	90.41
Commercial	121.59
Industrial	208.36
Land Conservation	155.89
No Zoning	317.76
Residential	284.78
Special Use	153.68
Total	1,332.47

Land Ownership		
Private Ownership		1,332.47
Non-Federal Sponsor		216.82
Other prior non-federal sponsor		3.04
	Total	1,552.33

Contracts		
1. Northeast Jackson		396.55
2. Floodwall & Eubanks		70.05
3. Town & Lynch Creeks		62.98
4. South Jackson		146.83
5. Belhaven		26.04
6. Flowood		347.41
7. Richland		165.21
8. Fairgrounds Levee		6.58
9. East Jackson Levee		110.82
10. Mitigation		1,228.00
	Total	2,560.47

III. NFS-OWNED LERRD

Approximately 216.82 acres of the existing Jackson (Fairgrounds) and East Jackson Levee project (completed by the Corps in 1968) are included in this project. These acres are previously encumbered with an estate equal to the proposed estate for the raising of these levees and will not be eligible for credit. The non-federal sponsor, Rankin-Hinds Pearl River Flood and Drainage Control District presently operates and maintains these levees and will make these lands available for project construction purposes as part of the overall LERDD requirements.

IV. NON-STANDARD ESTATES

4.1. In addition to the levees, limited clearing along the banks of the Pearl River will be required for this project. The standard clearing and snagging easement limits the clearing of trees to those of eight inches in diameter and less. A non-standard clearing and snagging easement excluding the exception to only trees of eight inches in diameter and less will be required to reduce stages at Lakeland Drive and minimize adverse impacts to the tailwater on the Ross Barnett Spillway.

4.2. A perpetual and assignable right and easement for the purposes of occasionally conducting snagging and clearing operations along the banks of the river, including the right to trim, cut, fell, remove and dispose of any and all trees, brush, obstacles or other vegetation; reserving, however, to the

landowners, their heirs and assigns all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

4.3. The above non-standard estate was approved through an internal office memorandum, dated 4 April 2006, by the Vicksburg District Chief of Real Estate, in accordance with ER 405-1-12, Chapter 12, Real Estate Roles and Responsibilities for Civil Works: Cost Shared and Full Federal Projects, Paragraph 12-10.c., 1 May 1998, as shown in Exhibit II.

V. EXISTING FEDERAL OR OVERLAPPING PROJECTS

5.1. The Rankin-Hinds Pearl River Flood and Drainage Control District is the non-federal sponsor in the construction of the Jackson (Fairgrounds) and East Jackson Levees project completed by the Corps in 1968 and presently operates and maintains said levees.

5.2. Removal of material from 600 ft upstream to 500 feet downstream of the HWY 25 bridge on the west bank of the Pearl River was completed by the Pearl River Basin Development District in 1983. The approximately 3.04 acres of this prior project are previously encumbered with an estate greater than the proposed Clearing and Snagging easement. These lands will be made available for project construction purposes.

5.3. A Clearing Plan along the Pearl River, by the Corps was completed in January 1985. The area was from the Woodrow Wilson Bridge to about 2.4 miles downstream of I-20. Some of these clearing areas will be included in this project for Levee and Borrow easements and this required additional interest in the same land will be eligible for credit. The non-federal sponsor for this prior project was the Pearl River Basin Development District. The number of overlapping acres is unknown at this time.

VI. FEDERALLY-OWNED LAND

In the mid to late 1970's, 3.75 acres was acquired in fee for the Jackson-East Jackson Flood Control Project (West bank slide area), a bank stabilization project by the Mobile District. Information concerning the acres impacted by this project is unknown at this time.

VII. LAND WITHIN THE NAVIGATION SERVITUDE

Navigation servitude will not be applicable to this project since the project lies above the Ordinary High Water Line (O.H.W.L.) of the Pearl River.

VIII. MAP

See Exhibit III

IX. INDUCED FLOODING

The proposed levees will increase water levels as much as 1 foot with larger floods in the vicinity of Lakeland Drive. The existing commercial development on the west bank of the Pearl River either side of Lakeland Drive will be adversely affected. Prior investigations show that a levee or floodwall could not be constructed without acquiring many of the existing buildings in this area. Thus, the recommended plan includes the total acquisition of this area, approximately 25.31 acres. Due to the passage of time since the previous report, and the continued construction, relocation of these facilities in adjacent areas may be difficult.

X. BASELINE COST ESTIMATE FOR REAL ESTATE

See Exhibit I

XI. RELOCATION ASSISTANCE BENEFITS

11.1. The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended by the Uniform Relocation Act Amendments of 1987, Title IV of the Surface Transportation and the Uniform Relocation Assistance Act of 1987 (PL 100-17), "provides for uniform and equitable treatment of persons displaced from their homes, businesses, or farms by Federal or Federally assisted programs and to establish uniform and equitable land acquisition policies for Federal or Federally assisted programs". Approximately 61 residences, 44 commercial/ industrial buildings, 144 tenants and one sign will be impacted as a result of this proposed work, requiring Title II relocation assistance benefits. The estimated cost to cover PL 91-646, Title II, is $4,390,000.00, as shown in Exhibit I.

11.2. Additionally, some Title III costs are anticipated. Title III costs are those necessary to reimburse owners fair and reasonable expenses necessarily incurred incidental to transfer of title, including recording fees, transfer taxes, penalty costs for prepayment of mortgage, pro rata portions of real estate taxes, etc. The estimated cost to cover PL 91-646, Title III, is $74,300.00, as shown in Exhibit I.

XII. MINERAL ACTIVITY

There is no known mineral activity within the project area.

XIII. ASSESSMENT OF NFS'S RE ACQUISITION CAPABILITY

13.1. The sponsor, Rankin-Hinds Pearl River Flood and Drainage Control District, will be responsible for providing all the necessary real estate interest associated with the project.

13.2. See Exhibit IV (Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability).

XIV. ZONING

There is no known application or enactment of zoning ordinances associated with this project.

XV. UTILITY AND FACILITY RELOCATIONS

Approximately 47 utilities involving 5 utility owners have been identified as requiring relocation as part of this project. No new rights-of-way are anticipated for the relocation of any utilities. When this plan is selected for construction, attorney's opinions of compensable interest will be prepared for the impacted utilities.

XVI. HTRW

A Preliminary Site Assessment was completed in November 1990 and an aerial HTRW survey was completed in 1992. No known or observed Hazardous, Toxic and Radioactive Waste (HTRW) sites were identified.

XVII. LANDOWNER ATTITUDES

At this time, early planning phase, there is no known landowner opposition to this plan. More information concerning landowner's attitudes will be gained from future public meetings.

XVIII. ACQUISITION OF LERRDS BEFORE PCA SIGNING

The non-Federal sponsor has been notified of the risks associated with acquiring lands prior to the signing of the PCA.

XIX. OTHER RELEVANT REAL ESTATE ISSUES

Acquisition of said project lands will not be conducted until all applicable National Environmental Policy Act (NEPA) requirements have been satisfactorily achieved.

This project's updated Environmental Assessment is ongoing at this time.

A cultural resource investigation has been completed and is in the review process at this time.

Glynn Mize
Prepared by
Glynn Mize
Realty Specialist
17 October 2006

Burke S. Torrey
Approving official
BURKE S. TORREY
CHIEF, Real Estate Division
Vicksburg District

EXHIBITS:
I. Baseline Cost Estimate
II. Non-Standard Estate
III. Right-of-Way Map
IV. Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability

SUMMARY OF REAL ESTATE COST

20-Sep-06

CONTRACT No. 1 (Northeast Jackson Levee)

A. Lands and Damages

Fee Simple - Island

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Office Building	26	5,994	SF	$60.00	$9,350,640
Restaurant	2	4,883	SF	$50.00	$488,300
Convenience Store	1	1,731	SF	$75.00	$129,825
Retail/Store/Commercial	2	5,505	SF	$50.00	$550,500
Concrete Paved Parking Lot	1	9,000	SF	$2.50	$22,500
Asphalt Paved Parking Lot	1	8,000	SF	$1.50	$12,000
Asphalt Paved Street	1	13,200	SF	$1.50	$19,800
Commercial Land (Acres)	25.31	1,102,504	SF	$3.00	$3,307,512
Subtotal					$13,881,077
Severance Damage (10%)					$1,388,108
Total Value (Fee Simple)					$15,269,185
Estimated Compensation to Property Owner 100%					$15,269,185

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Woodland	254.32		Acre	$1,000.00	$254,320
Subtotal					$254,320
Severance Damage (10%)					$25,432
Total Value (Fee Simple)					$279,752
Estimated Compensation to Property Owner 90%					$251,777

Snagging & Clearing Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Woodland	116.92		Acre	$1,000.00	$116,920
Subtotal					$116,920
Severance Damage (10%)					$11,692
Total Value					$128,612
Estimated Compensation to Property Owner 80%					$102,890
Sub-Total Lands and Damages					$15,623,851
Contingencies (25%)					$3,905,963
Total Lands and Damages 01R1					$19,529,814

Exhibit I

B. Acquisition Cost (Based on 98 Tracts from 70 Ownerships)

Project Planning	01A	$14,300
Acquisition	01B	$677,125
Condemnations	01C	$212,000
Appraisals	01E	$250,485
PL 91-646	01F	$304,000
Permits	01G	$35,000
Project Administration	01M	$220,000
Utility Relocations	01N	$18,000
Sub-Total		$1,730,910
Contingencies (25%)		$432,728
Total Acquisition Costs		$2,163,638

C. Public Law 91-646

Title II		$2,000,000
Title III		$21,000
Sub-Total		$2,021,000
Contingencies (25%)		$505,250
Total P.L. 91-646 Costs	01R2	$2,526,250

D. **Total Contract No. 1 Estimated Real Estate Costs** **$24,219,701**

CONTRACT No. 2 (Floodwall and Enbanks Levee)

A. Lands and Damages

Flood Protection Levee & Borrow Easements

PROPERTY TYPE		NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Residential Land	(Acres)	0.27	1	Lot	$20,000.00	$20,000
Commercial Land	(Acres)	0.56	24,394	SF	$5.00	$121,968
Low Frequently Flooded Woodland		39.99		Acre	$1,000.00	$39,990
Subtotal						$181,958
Severance Damage (10%)						$18,196
Total Value						$200,154
Estimated Compensation to Property Owner 90%						$180,138

Snagging & Clearing Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Woodland	29.23		Acre	$1,000.00	$29,230
Subtotal					$29,230
Severance Damage (10%)					$2,923
Total Value					$32,153
Estimated Compensation to Property Owner 80%					$25,722

Sub-Total Lands and Damages		$205,861
Contingencies (25%)		$51,465
Total Lands and Damages	01R1	$257,326

B. Acquisition Cost (Based on 9 Tracts from 7 Ownerships)

Project Planning	01A	$14,300
Acquisition	01B	$100,725
Condemnations	01C	$22,000
Appraisals	01E	$57,895
PL 91-646	01F	$6,000
Permits	01G	$4,000
Project Administration	01M	$34,000
Utility Relocations	01N	$5,000
Sub-Total		$243,920
Contingencies (25%)		$60,980
Total Acquisition Costs		$304,900

C. Public Law 91-646

Title II		$20,000
Title III		$2,000
Sub-Total		$22,000
Contingencies (25%)		$5,500
Total P.L. 91-646 Costs	01R2	$27,500

D. **Total Contract No. 2 Estimated Real Estate Costs** **$589,726**

CONTRACT No. 3 (Town & Lynch Creeks Levee)

A. Lands and Damages

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Woodland	62.98		Acre	$1,000.00	$62,980
Subtotal					$62,980
Severance Damage (10%)					$6,298
Total Value					$69,278
Estimated Compensation to Property Owner 90%					$62,350
Sub-Total Lands and Damages					$62,350
Contingencies (25%)					$15,588
Total Lands and Damages	01R1				$77,938

B. Acquisition Cost (Based on 10 Tracts from 7 Ownerships)

Project Planning	01A	$14,300
Acquisition	01B	$106,225
Condemnations	01C	$22,000
Appraisals	01E	$58,395
PL 91-646	01F	$3,000
Permits	01G	$4,000
Project Administration	01M	$37,000
Utility Relocations	01N	$13,000
Sub-Total		$257,920
Contingencies (25%)		$64,480
Total Acquisition Costs		$322,400

C. Public Law 91-646

Title II		$0
Title III		$2,000
Sub-Total		$2,000
Contingencies (25%)		$500
Total P.L. 91-646 Costs	01R2	$2,500

D. **Total Contract No. 3 Estimated Real Estate Costs** **$402,838**

CONTRACT No. 4 (South Jackson Levee)

A. Lands and Damages

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Industrial Land (Acres)	18.18		Acre	$30,000.00	$545,400
Low Frequently Flooded Woodland	128.65		Acre	$1,000.00	$128,650
Subtotal					$674,050
Severance Damage (10%)					$67,405
Total Value					$741,455
Estimated Compensation to Property Owner 90%					$667,310
Sub-Total Lands and Damages					$667,310
Contingencies (25%)					$166,827
Total Lands and Damages 01R1					$834,137

B. Acquisition Cost (Based on 22 Tracts from 16 Ownerships)

Project Planning	01A	$14,300
Acquisition	01B	$203,905
Condemnations	01C	$49,000
Appraisals	01E	$105,125

PL 91-646	01F	$7,000
Permits	01G	$8,000
Project Administration	01M	$63,000
Utility Relocations	01N	$8,000
Sub-Total		$458,330
Contingencies (25%)		$114,583
Total Acquisition Costs		$572,913

C. Public Law 91-646

Title II		$0
Title III		$5,000
Sub-Total		$5,000
Contingencies (25%)		$1,250
Total P.L. 91-646 Costs	01R2	$6,250

D. **Total Contract No. 4 Estimated Real Estate Costs** **$1,413,299**

CONTRACT No. 5 (Belhaven Levee)

A. Lands and Damages

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Woodland	26.04		Acre	$1,000.00	$26,040
Subtotal					$26,040
Severance Damage (10%)					$2,604
Total Value					$28,644
Estimated Compensation to Property Owner 90%					$25,780
Sub-Total Lands and Damages					$25,780
Contingencies (25%)					$6,445
Total Lands and Damages	01R1				$32,225

B. Acquisition Cost (Based on 4 Tracts from 3 Ownerships)

Project Planning	01A	$14,300
Acquisition	01B	$51,095
Condemnations	01C	$19,000
Appraisals	01E	$30,645
PL 91-646	01F	$2,000
Permits	01G	$2,000
Project Administration	01M	$19,000
Utility Relocations	01N	$0
Sub-Total		$138,040

Contingencies (25%)	$34,510
Total Acquisition Costs	$172,550

C. Public Law 91-646

Title II	$0
Title III	$1,000
Sub-Total	$1,000
Contingencies (25%)	$250
Total P.L. 91-646 Costs 01R2	$1,250

D. **Total Contract No. 5 Estimated Real Estate Costs** **$206,025**

CONTRACT No. 6 (Flowood Levee)

A. Lands and Damages

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Residential Single Family	58	1,500	SF	$90.00	$7,830,000
Retail/Store/Commercial	1	10,543	SF	$50.00	$527,150
Amusement Park	1	6,000	SF	$50.00	$300,000
Office Building	5	8,275	SF	$70.00	$2,896,250
Asphalt Street (Sara Lane)	1	14,700	SF	$1.50	$22,050
Asphalt Paved Parking Lot	1	30,000	SF	$1.50	$45,000
Residential Land (*)	17.51		Acre		
Commercial Land (Acres)	42.26	1,840,846	SF	$5.00	$9,204,228
Low Frequently Flooded Woodland	229.18		Acre	$1,000.00	$229,180
Subtotal					$21,053,858
Severance Damage (10%)					$2,105,386
Total Value					$23,159,244
Estimated Compensation to Property Owner 90%					$20,843,319

* Land value included in unit price per square foot of single family residence

Snagging & Clearing Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Woodland	58.46		Acre	$1,000.00	$58,460
Subtotal					$58,460
Severance Damage (10%)					$5,846
Total Value					$64,306
Estimated Compensation to Property Owner 80%					$51,445

Sub-Total Lands and Damages	$20,894,764
Contingencies (25%)	$5,223,691
Total Lands and Damages 01R1	$26,118,455

B. Acquisition Cost (Based on 98 Tracts from 76 Ownerships)

Project Planning	01A	$14,300
Acquisition	01B	$641,790
Condemnations	01C	$230,000
Appraisals	01E	$264,510
PL 91-646	01F	$230,000
Permits	01G	$38,000
Project Administration	01M	$218,000
Utility Relocations	01N	$15,000
Sub-Total		$1,651,600
Contingencies (25%)		$412,900
Total Acquisition Costs		$2,064,500

C. Public Law 91-646

Title II		$2,020,000
Title III		$23,000
Sub-Total		$2,043,000
Contingencies (25%)		$510,750
Total P.L. 91-646 Costs	01R2	$2,553,750

D. **Total Contract No. 6 Estimated Real Estate Costs** **$30,736,705**

CONTRACT No. 7 (Richland Levee)

A. Lands and Damages

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Residential Single Family	3	1,500	SF	$90.00	$405,000
Retail/Store/Commercial	1	10,543	SF	$50.00	$527,150
Light Industrial	3	14,116	SF	$30.00	$1,270,440
Residential Land (*)	5.74		Acre		
Industrial Land (Acres)	13.50		SF	$30,000.00	$405,000
Low Frequently Flooded Woodland	145.97		Acre	$1,000.00	$145,970
Subtotal					$2,753,560
Severance Damage (10%)					$275,356
Total Value (Fee Simple)					$3,028,916
Estimated Compensation to Property Owner 90%					$2,726,024

* Land value included in unit price per square foot of single family residence

Sub-Total Lands and Damages		$2,726,024
Contingencies (25%)		$681,506
Total Lands and Damages	01R1	$3,407,531

B. Acquisition Cost (Based on 52 Tracts from 41 Ownerships)

Project Planning	01A	$14,300
Acquisition	01B	$454,910
Condemnations	01C	$124,000
Appraisals	01E	$201,390
PL 91-646	01F	$50,000
Permits	01G	$21,000
Project Administration	01M	$136,000
Utility Relocations	01N	$10,000
Sub-Total		$1,011,600
Contingencies (25%)		$252,900
Total Acquisition Costs		$1,264,500

C. Public Law 91-646

Title II		$250,000
Title III		$12,000
Sub-Total		$262,000
Contingencies (25%)		$65,500
Total P.L. 91-646 Costs	01R2	$327,500

D. **Total Contract No. 7 Estimated Real Estate Costs** **$4,999,531**

CONTRACT No. 8 (Fairgrounds Levee)

A. Lands and Damages

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Woodland	6.58		Acre	$1,000.00	$6,580
Subtotal					$6,580
Severance Damage (10%)					$658
Total Value (Fee Simple)					$7,238
Estimated Compensation to Property Owner 90%					$6,514
Sub-Total Lands and Damages					$6,514
Contingencies (25%)					$1,629
Total Lands and Damages	01R1				$8,143

B. Acquisition Cost (Based on 1 Tracts from 1 Ownership)

Project Planning	01A	$14,300
Acquisition	01B	$25,845
Condemnations	01C	$19,000
Appraisals	01E	$23,565
PL 91-646	01F	$1,000

Permits	01G	$1,000
Project Administration	01M	$19,000
Utility Relocations	01N	$15,000
Sub-Total		$118,710
Contingencies (25%)		$29,678
Total Acquisition Costs		$148,388

C. Public Law 91-646

Title II		$0
Title III		$300
Sub-Total		$300
Contingencies (25%)		$75
Total P.L. 91-646 Costs	01R2	$375

D. **Total Contract No. 8 Estimated Real Estate Costs** **$156,905**

CONTRACT No. 9 (East Jackson Levee)

A. Lands and Damages

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Light Industrial	2	14,116	SF	$30.00	$846,960
Sign	1		SF	$40,000.00	$40,000
Industrial Land (Acres)	18.50		SF	$30,000.00	$555,000
Low Frequently Flooded Woodland	63.09		Acre	$1,000.00	$63,090
Subtotal					$1,505,050
Severance Damage (10%)					$150,505
Total Value					$1,655,555
Estimated Compensation to Property Owner 90%					$1,490,000

Snagging & Clearing Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Woodland	29.23		Acre	$1,000.00	$29,230
Subtotal					$29,230
Severance Damage (10%)					$2,923
Total Value					$32,153
Estimated Compensation to Property Owner 80%					$25,722

Sub-Total Lands and Damages		$1,515,722
Contingencies (25%)		$378,930
Total Lands and Damages	01R1	$1,894,652

B. Acquisition Cost (Based on 28 Tracts from 21 Ownerships)

Project Planning	01A	$14,300
Acquisition	01B	$252,945
Condemnations	01C	$65,000
Appraisals	01E	$126,595
PL 91-646	01F	$20,000
Permits	01G	$11,000
Project Administration	01M	$89,000
Utility Relocations	01N	$35,000
Sub-Total		$613,840
Contingencies (25%)		$153,460
Total Acquisition Costs		$767,300

C. Public Law 91-646

Title II		$100,000
Title III		$6,000
Sub-Total		$106,000
Contingencies (25%)		$26,500
Total P.L. 91-646 Costs	01R2	$132,500

D. **Total Contract No. 9 Estimated Real Estate Costs** **$2,794,452**

CONTRACT No. 10 (Mitigation)

A. Lands and Damages

Fee Simple

PROPERTY TYPE		NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Agricultural (cropland)	Acres	1228.0		Acre	$1,000.00	$1,228,000
Total Value (Fee Simple)						$1,228,000
Estimated Compensation to Property Owner 100%						$1,228,000
Sub-Total Lands and Damages						$1,228,000
Contingencies (25%)						$307,000
Total Lands and Damages	01R1					$1,535,000

B. Acquisition Cost (Based on 6 Tracts from 6 Ownerships)

Project Planning	01A	$14,300
Acquisition	01B	$83,500
Condemnations	01C	$0
Appraisals	01E	$51,810
PL 91-646	01F	$3,000
Permits	01G	$3,000

Project Administration	01M	$25,000
Utility Relocations	01N	$0
Sub-Total		$180,610
Contingencies (25%)		$45,153
Total Acquisition Costs		$225,763

C. Public Law 91-646

Title II		$0
Title III		$2,000
Sub-Total		$2,000
Contingencies (25%)		$500
Total P.L. 91-646 Costs	01R2	$2,500

D. **Total Contract No. 10 Estimated Real Estate Costs** **$1,763,263**

PROJECT SUMMARY
ALL CONTRACTS

Total Lands and Damages Costs	$53,695,220
Acquisition Costs	$8,006,850
PL 91-646 Costs	$5,580,375
Project Total	**$67,282,445**

CEMVK-RE-P (405) Mize/mgm/1-5247 DATE: 4 April 2006

MEMORANDUM FOR CEMVK-RE, ATTN: MR. TORREY

SUBJECT: Non-Standard Estate Approval, Clearing and Snagging

1. Authority/References:

a. CEMVD-ET-R Memorandum, Sept 1998, Subject: Final Version of Updated Chapter 12, EC 405-2-12, Real Estate Roles and Responsibilities for Civil Works: Cost Shared and Full Federal Projects, Paragraph 6.

b. ER 405-1-12, Chapter 12, Real Estate Roles and Responsibilities for Civil Works: Cost Shared and Full Federal Projects, Paragraph 12-10.c., 1 May 1998.

c. EC 405-1-11, Exhibit 5-29, Standard Estates, 25. Snagging and Clearing Easement

2. For your review and approval as authorized in paragraph 1.b., is a non-standard clearing and snagging easement estate. Right-of-way for the purpose of clearing along the banks of the Pearl River within the project area for the Pearl River Watershed, Mississippi, in Hinds and Rankin Counties, is required. The standard clearing and snagging estate as contained in reference item 1.c. limits the removal and disposal of trees to those having a diameter of 8 inches and less. The required estate, as dictated below, is a standard perpetual clearing and snagging easement modified to exclude the exception to trees having a diameter exceeding 8 inches.

A perpetual and assignable right and easement for the purposes of occasionally conducting snagging and clearing operations along the banks of the river, including the right to trim, cut, fell, remove and dispose of any and all trees, brush, obstacles or other vegetation; reserving, however, to the landowners, their heirs and assigns all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

Exhibit II

CEMVK-RE-P
SUBJECT: Non Standard Estate Approval

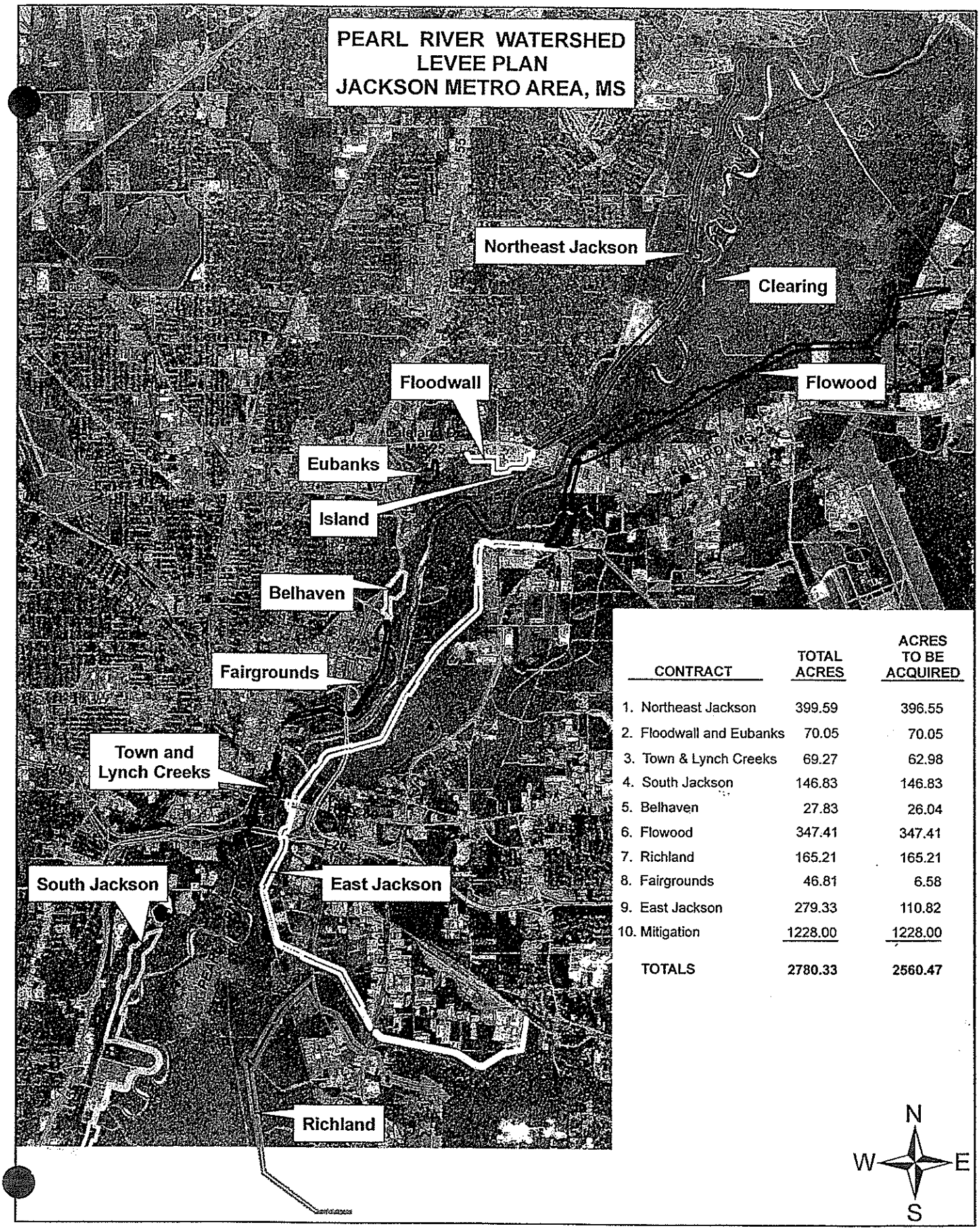
3. Request approval of the above non standard estate for the purpose stated.

Marion K. White
Ken White
Chief, Appraisal and Planning

APPROVE

DISAPPROVE

Burke S. Torrey
BURKE S. TORREY
Chief, Real Estate Division



CONTRACT	TOTAL ACRES	ACRES TO BE ACQUIRED
1. Northeast Jackson	399.59	396.55
2. Floodwall and Eubanks	70.05	70.05
3. Town & Lynch Creeks	69.27	62.98
4. South Jackson	146.83	146.83
5. Belhaven	27.83	26.04
6. Flowood	347.41	347.41
7. Richland	165.21	165.21
8. Fairgrounds	46.81	6.58
9. East Jackson	279.33	110.82
10. Mitigation	1228.00	1228.00
TOTALS	2780.33	2560.47

Exhibit III

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

PROJECT NAME: LeFleur Lakes Project
LOCAL SPONSOR: Rankin-Hinds Pearl River Flood and Drainage Control District

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purpose? (Yes/No)
b. Does the sponsor have the power of eminent domain for this project? ..... (Yes/No)
c. Does the sponsor have "quick-take" authority for this project? ..... (Yes/No)
d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? ..... (Yes/No)
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? ..... (Yes/No)

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? .....SEE NOTE 1 . . . . . (Yes/No)
b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training? N/A (Yes/No)
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? ..... SEE NOTE 2 ..... (Yes/No)
d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? .....SEE NOTE 2 ..... (Yes/No)
e. Can the sponsor obtain contractor support, if required, in a timely fashion? ..... (Yes/No)
f. Will the sponsor likely request USACE assistance in acquiring real estate? ..... (Yes/No)
(If "yes", provide description).

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? ..... (Yes/No)
b. Has the sponsor approved the project/real estate schedule/milestones? ..... (Yes/No)

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? ..... (Yes/No/Not applicable)
b. With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable. (If sponsor is believed to be "insufficiently capable", provide explanation).

V. Coordination

a. Has this assessment been coordinated with the sponsor? ..... (Yes/No)
b. Does the sponsor concur with this assessment? ..... (Yes/No)
(If "no", provide explanation).

Prepared by:

Bill Mayfield
Realty Specialist

26 Sept 2006
Date

Reviewed and approved by:

Burke S. Torrey
Chief, Real Estate Division

26 Sept 2006
Date

NOTE 1 – Local Sponsor has indicated that real estate acquisition to include P.L. 91-646 will be contracted.

NOTE 2 – Sponsor has indicated that all real estate acquisition will be contracted.

REAL ESTATE PLAN
PEARL RIVER WATERSHED, MISSISSIPPI
LEFLEUR LAKES ALTERNATIVE PLAN
HINDS, MADISON and RANKIN COUNTIES, MISSISSIPPI

I. PURPOSE OF REAL ESTATE PLAN

1.0. The purpose of this Real Estate Plan (REP) is to provide the real estate requirements for the cost shared Pearl River Watershed, Mississippi, Lefleur Lakes Alternative Plan. The information contained within this report is tentative in nature and is subject to change even after approval of this REP.

1.1. The purpose of the project is to provide flood control, reducing damages to existing development from headwater flooding caused by infrequent heavy rainfalls over the upper Pearl River Basin. The Lefleur Lakes Alternative is being supplemented to the 1996 Jackson Metropolitan Area, Mississippi, Feasibility Report, as the locally preferred alternative. A REP for the levee plan, recommended by said report, was approved 12 October 1995. An updated REP was completed on 17 October 2006 for said levee plan. There have been no prior REPs for this lake plan.

1.2. The project area is located in central Mississippi south of the Ross Barnett Reservoir, along the Pearl River and north of Elton Road in the City of Jackson and north of Cleary Road in the town of Richland. Area municipalities include Jackson in Hinds County, Ridgeland in Madison County and Flowood, Pearl and Richland in Rankin County.

1.3. This alternative includes construction of two weirs, three levee segments, three pump stations, two floodgates, a box culvert, pipe water control structures, constructing landside connecting ditches, slurry trenches, seepage berms with a layer of riprap for toe protection, an existing levee realignment, modifying an existing pump station, relocation of an existing gravity outlet structure and blocking other existing gravity outlet structures.

II. DESCRIPTION OF LERRD (Lands, Easements & Rights of Way)

2.1. This alternative would be divided into 5 segments: Segment 1 - Spillway to HWY 25, Segment 2 - HWY 25 to Weir No. 1, Segment 3 - Weir No. 1 to Weir No. 2 including the Town and Lynch Creeks Levee, Segment 4 - everything south of Weir No. 2 including South Jackson and Richland Levees and Segment 5 - mitigation lands, as shown in Exhibit I.

2.2. The total acreage required for this alternative is approximately 16,824.9 acres with approximately 526 tracts involving 359 owners, including the mitigation lands. Of the total project acreage: 625.76 acres will be covered by navigational servitude, 60.95 acres will be sponsor owned and 99.57 acres will require permits, leaving 16,038.62 acres of Lands, Easements, Right-of-way, Relocations and Disposal areas (LERRD) to be acquired. Of the LERRD to be acquired: 12,161.86 acres will be in Fee (8,080.0 acres for mitigation lands and 4,081.86 acres of project right-of-way), 1,208.93 acres will be Flowage Easement (Occasional Flooding), 2,324.43 acres will be Temporary Construction Easement and 343.4 acres will be Perpetual Levee/Borrow Easement (as shown below). Of the preliminary right-of-way (ROW) acres identified on present mapping, no separation between levee and borrow acres has been made at this time. Borrow areas are presently located on the riverside adjacent to the proposed levees, however, in the event material from these sites proves to be unsuitable, then satellite pits will be acquired to provide satisfactory materials. The total estimated market value for the LERRD to be acquired is $174,566,697 inclusive of contingencies, as shown in Exhibit II.

ACRES TO BE ACQUIRED

SEGEMENT	FEE	FLOWAGE EASEMENT	5-YEAR TEMPORARY CONSTRUCTION EASEMENT	PERPETUAL LEVEE AND BORROW EASEMENT	TOTAL ACRES
1	2,837.22	915.20	1,774.58	0.00	5,527.00
2	880.31	256.19	542.98	0.00	1,679.48
3	289.27	26.19	6.87	31.36	353.69
4	75.06	11.35	0.00	312.04	398.45
5	8,080.00	0.00	0.00	0.00	8,080.00
TOTALS	12,161.86	1,208.93	2,324.43	343.40	
				TOTAL ACRES TO BE ACQUIRED :	16,038.62

III. NFS-OWNED LERRD

The sponsor, Rankin-Hinds Pearl River Flood and Drainage Control District, presently operates and maintains the existing Jackson (Fairgrounds) and East Jackson Levees. The proposed Lefleur Lakes Alternative Plan will require an additional fee interest over the existing levee estate from approximately the toe of the levee to the riverside right-of-way line. This additional interest will be eligible for credit and is included in the acres to be acquired. The number of acres is unknown at this time.

IV. NON-STANDARD ESTATES

There are no non-standard estates to be utilized with this project.

V. EXISTING FEDERAL OR OVERLAPPING PROJECTS

5.1. The Rankin-Hinds Pearl River Flood and Drainage Control District was the non-federal sponsor in the construction of the Jackson (Fairgrounds) and East Jackson Levees project completed by the Corps in 1968 and presently operates and maintains said levees as previously mentioned in paragraph III. In addition to the levees, 5.34 miles of river channel work was completed. The previously encumbered channel acreage impacted by this project will be encumbered with a greater estate, fee. The number of channel acres is unknown at this time.

5.2. Removal of material from 600 ft upstream to 500 feet downstream of the HWY 25 Bridge along the west bank of the Pearl River was completed by the Pearl River Basin Development District in 1983. These approximately 11.25 fee acres were credited toward the local share of the 1983 project costs (thus non-creditable for this project) will be made available for project construction purposes.

5.3. A Clearing Plan along the Pearl River by the Corps was completed in January 1985. The area was from the Woodrow Wilson Bridge to about 2.4 miles downstream of I-20. Most of these clearing areas would be included in this alternative for fee and levee and borrow easements; and this required additional interest in the same land will be eligible for credit. The non-federal sponsor for this prior project was the Pearl River Basin Development District. The number of overlapping acres is unknown at this time.

VI. FEDERALLY-OWNED LAND

In the mid to late 1970's, 3.75 acres was acquired in fee along the west bank of the Pearl River for the Jackson-East Jackson Flood Control Project (West bank slide area), a bank stabilization project by the Mobile District. Although digital information of this area is not available at this time, it appears that most of these acres would be impacted by this alternative. At this time there are no known concerns of these acres being used for the purpose of this project.

VII. LAND WITHIN THE NAVIGATION SERVITUDE

Approximately 625.76 acres of this proposed project are below the Ordinary High Water Line (O.H.W.L.) of the Pearl River and is considered to be a part of navigational servitude. The rights afforded by navigational servitude are considered sufficient for the proposed work; therefore no rights-of-way will be acquired below the O.H.W.L. of the Pearl River.

VIII. MAP

See Exhibit I

IX. INDUCED FLOODING

The construction of the proposed two weirs/lakes would induce flooding. It would require acquisition from approximately 302 owners of approximately 7,615.22 acres of Fee, Flowage Easements and Temporary Construction Easements and also approximately 100 various types of improvements, as shown in Exhibit II.

X. BASELINE COST ESTIMATE FOR REAL ESTATE

See Exhibit II.

XI. RELOCATION ASSISTANCE BENEFITS

11.1. The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended by the Uniform Relocation Act Amendments of 1987, Title IV of the Surface Transportation and the Uniform Relocation Assistance Act of 1987 (PL 100-17), "provides for uniform and equitable treatment of persons displaced from their homes, businesses, or farms by Federal or Federally assisted programs and to establish uniform and equitable land acquisition policies for Federal or Federally assisted programs". Approximately 42 residences, 2 apartment complexes, 1 duplex, 32 office buildings, 5 commercial retail stores, 5 warehouses, 3 repair shops, 1 church and 332 tenants will be impacted as a result of this proposed work, requiring Title II relocation assistance benefits. The estimated cost to cover PL 91-646, Title II, is $15,150,000.00, as shown in Exhibit II.

11.2. Additionally, some Title III costs are anticipated. Title III costs are those necessary to reimburse owners fair and reasonable expenses necessarily incurred incidental to transfer of title, including recording fees, transfer taxes, penalty costs for prepayment of mortgage, pro rata portions of real estate taxes, etc. The estimated cost to cover PL 91-646, Title III, is $133,750.00, as shown in Exhibit II.

XII. MINERAL ACTIVITY

There is no known mineral activity within the project area.

XIII. ASSESSMENT OF NFS'S RE ACQUISITION CAPABILITY

13.1. The sponsor, Rankin-Hinds Pearl River Flood and Drainage Control District, will be responsible for providing all the necessary real estate interest associated with the project.

13.2. See Exhibit III (Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability).

XIV. ZONING

There is no known application or enactment of zoning ordinances associated with this project.

XV. UTILITY AND FACILITY RELOCATIONS

Approximately 40 utilities involving 11 utility owners have been identified as requiring relocation as part of this project. No new rights-of-way are anticipated for the relocation of any utilities. If this plan is recommended for construction, attorney's opinions of compensable interest would be prepared for the impacted utilities.

XVI. HAZARDOUS, TOXIC AND RADIOACTIVE WASTE (HTRW)

16.1. In 2005 a Phase 1 HTRW Site assessment was completed for the Gallatin Street land fill area.

16.2. Acquisition of said project lands would not be conducted until all applicable National Environmental Policy Act (NEPA) requirements have been satisfactorily achieved.

XVII. LANDOWNER ATTITUDES

At the time of this report, there is no known landowner opposition to this plan. More information concerning landowner's attitudes would be gained from future public meetings.

XVIII. ACQUISITION OF LERRDS BEFORE PCA SIGNING

The non-Federal sponsor has been notified of the risks associated with acquiring lands prior to the signing of the PCA.

XIX. OTHER RELEVANT REAL ESTATE ISSUES

19.1. Acquisition of said project lands would not be conducted until all applicable National Environmental Policy Act (NEPA) requirements have been satisfactorily achieved.

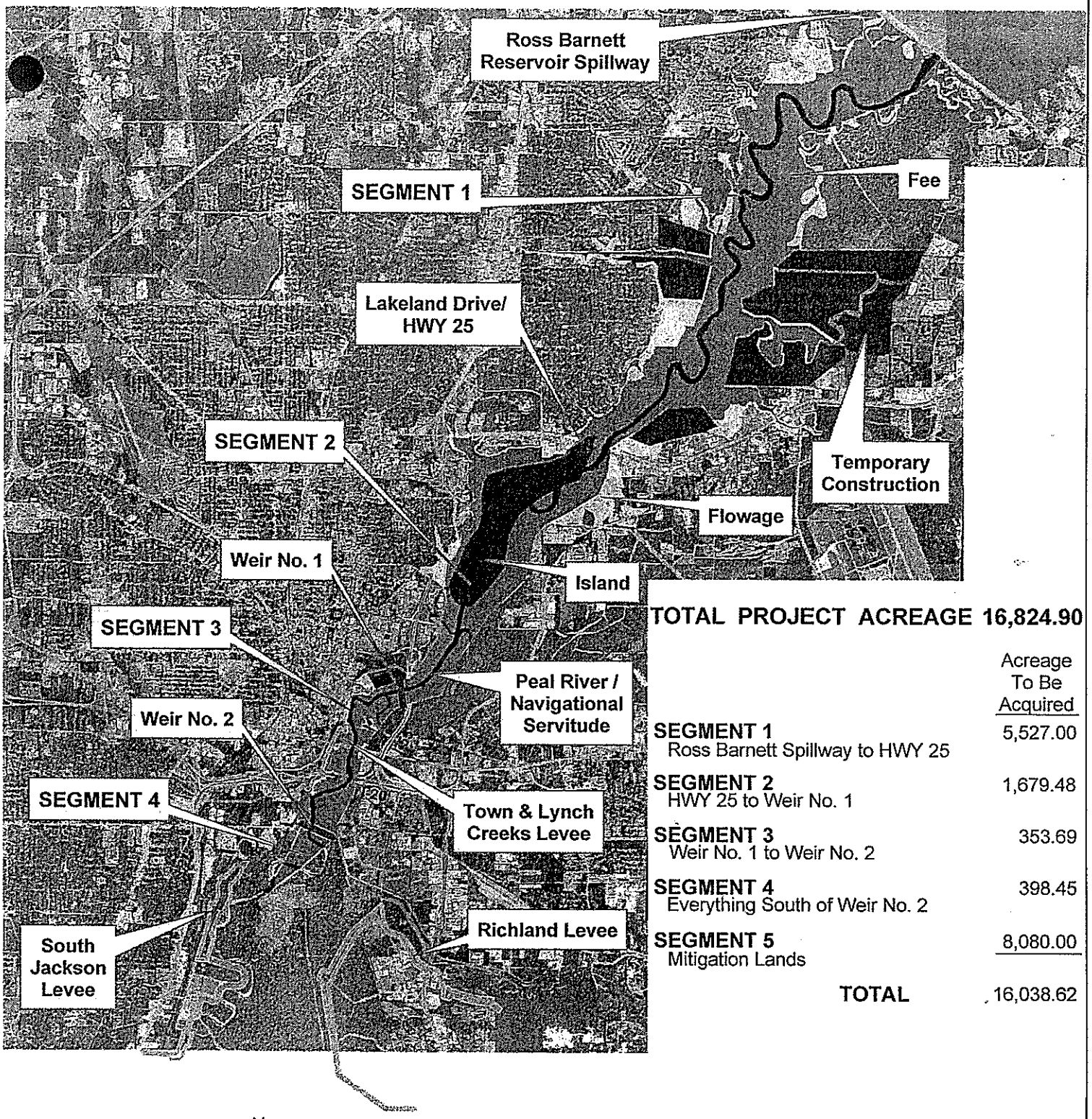
19.2. An updated Environmental Assessment is ongoing at this time.

19.3. A cultural resource investigation has been completed and is in the review process at this time.

Glynn Mize
Prepared by
Glynn Mize
Realty Specialist
2 November 2006

Burke S. Torrey
Approving official
BURKE S. TORREY
CHIEF, Real Estate Division
Vicksburg District

EXHIBITS:
I. Right-of-Way Map
II. Baseline Cost Estimate
III. Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability



TOTAL PROJECT ACREAGE 16,824.90

	Acreage To Be Acquired
SEGMENT 1 Ross Barnett Spillway to HWY 25	5,527.00
SEGMENT 2 HWY 25 to Weir No. 1	1,679.48
SEGMENT 3 Weir No. 1 to Weir No. 2	353.69
SEGMENT 4 Everything South of Weir No. 2	398.45
SEGMENT 5 Mitigation Lands	8,080.00
TOTAL	16,038.62

SCALE

0 0.5 1 2 3 4 Miles

PEARL RIVER WATERSHED
LEFLEUR LAKES PLAN
JACKSON METRO AREA, MS

Exhibit I

SUMMARY OF REAL ESTATE COST

3-Oct-06

SEGMENT No. 1 (Spillway to HWY 25)

A. Lands and Damages

Fee Simple

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA	UNIT TYPE	UNIT PRICE	TOTAL
Single Family Residence (*)	1	4,655.00	SF	$153.00	$712,215
Office Building	1	4,363.00	SF	$60.00	$261,780
Baseball Field					$200,000
Residential Land	1	21.19	Acre	$7,500.00	$158,925
Commercial Land	1	280,962.00	SF	$3.00	$842,886
Low Frequently Flooded Land	1	2,792.35	Acre	$1,000.00	$2,792,350
Subtotal					$4,968,156
Severance Damage (10%)					$496,816
Total Value (Fee Simple)					$5,464,972
Estimated Compensation to Property Owner 100%					$5,464,972

Flowage Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA	UNIT TYPE	UNIT PRICE	TOTAL
Single Family Residence (*)	12	4,500.00	SF	$153.00	$8,262,000
Single Family Residence (*)	1	2,500.00	SF	$71.00	$177,500
Single Family Residence (*)	1	2,700.00	SF	$70.00	$189,000
Single Family Residence (*)	2	3,400.00	SF	$104.00	$707,200
Single Family Residence (*)	8	3,600.00	SF	$81.00	$2,332,800
Single Family Residence (*)	6	3,800.00	SF	$141.00	$3,214,800
Single Family Residence (*)	6	3,500.00	SF	$95.00	$1,995,000
Duplex (*)	1	3,500.00	SF	$50.00	$175,000
Apartment Complex	2	144.00	APT	$45,000.00	$12,960,000
Office Building	9	14,873.00	SF	$70.00	$9,369,990
Warehouse	1	3,120.00	SF	$30.00	$93,600
Retail/Store/Commercial	4	10,617.00	SF	$50.00	$2,123,400
Repair Shop	2	8,856.00	SF	$50.00	$885,600
Amusement Park	1	6,218.00	SF	$50.00	$310,900
Asphalt Paved Parking Lot	2	22,350.00	SF	$1.50	$67,050
Baseball Field	1				$300,000
Track & Field Facility	1				$500,000
Golf Course	1				$1,000,000
Residential Land	1	33.52	Acre	$7,500.00	$251,400
Residential Apartment Land	1	15.67	Acre	$35,000.00	$548,450
Commercial Land	1	140.94	Acre	$50,000.00	$7,047,000
Commercial Land	1	3,663,832.00	SF	$5.00	$18,319,160
Industrial Land	1	9.60	Acre	$30,000.00	$288,000
Low Frequently Flooded Land	1	596.36	Acre	$1,000.00	$596,360
Subtotal					$71,714,210
Severance Damage (10%)					$7,171,421
Total Value (Fee Simple)					$78,885,631

Exhibit II

Estimated Compensation to Property Owner 90% (Rounded)					$70,997,068

Temporary Construction Easement

PROPERTY TYPE		NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Residential Apartment Land		1	4.10	Acre	$35,000.00	$143,500
Low Frequently Flooded Land		1	1,770.48	Acre	$1,000.00	$1,770,480
Subtotal						$1,913,980
Severance Damage (10%)						$191,398
Total Value						$2,105,378
Estimated Compensation to Property Owner 80% (Rounded)						$1,684,302
Sub-Total Lands and Damages						$78,146,342
Contingencies (25%)						$19,536,585
Total Lands and Damages	01R1					$97,682,927

B. Acquisition Cost (Based on 351 Tracts from 254 Ownerships)

Project Planning	01A	$24,800
Acquisition	01B	$2,195,555
Condemnations	01C	$767,000
Appraisals	01E	$1,101,965
PL 91-646	01F	$1,119,000
Permits	01G	$70,000
Project Administration	01M	$756,000
Utility Relocations	01N	$47,000
Sub-Total		$6,081,320
Contingencies (25%)		$1,520,330
Total Acquisition Costs		$7,601,650

C. Public Law 91-646

Title II		$10,650,000
Title III		$76,000
Sub-Total		$10,726,000
Contingencies (25%)		$2,681,500
Total P.L. 91-646 Costs	01R2	$13,407,500

D. **Total Segment No. 1 Estimated Real Estate Costs** **$118,692,077**

SEGMENT No. 2 (HWY 25 to Weir No. 1)

A. Lands and Damages

Fee Simple

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA OR AREA	UNIT TYPE	UNIT PRICE	TOTAL
Golf Course	1				$100,000
Residential Land		1.17	Acre	$7,500.00	$8,775
Commercial Land	1	503,554.00	SF	$3.00	$1,510,662
Commercial Land		20.00	Acre	$50,000.00	$1,000,000
Industrial Land		1.13	Acre	$30,000.00	$33,900
Low Frequently Flooded Land		100.00	Acre	No Value	$0
Low Frequently Flooded Land		689.84	Acre	$1,000.00	$689,840
Subtotal					$3,343,177
Severance Damage (10%)					$334,318
Total Value					$3,677,495
Estimated Compensation to Property Owner 100% (Rounded)					$3,677,495

Flowage Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA	UNIT TYPE	UNIT PRICE	TOTAL
Single Family Residence (*)	3	1,083.00	SF	$90.00	$292,410
Office Building	11	9,094.00	SF	$70.00	$7,002,380
Office Building	11	6,312.00	SF	$60.00	$4,165,920
Retail/Store/Commercial	1	9,373.00	SF	$50.00	$468,650
Repair Shop	1	16,579.00	SF	$50.00	$828,950
Church	1	2,288.00	SF	$40.00	$91,520
Asphalt Paved Parking Lot	2	8,100.00	SF	$1.50	$24,300
Residential Land		11.75	Acre	$7,500.00	$88,125
Commercial Land		583,268.00	SF	$3.00	$1,749,804
Commercial Land		1,728,461.00	SF	$5.00	$8,642,305
Commercial Land		14.44	Acre	$50,000.00	$722,000
Industrial Land		5.43	Acre	$30,000.00	$162,900
Low Frequently Flooded Land		162.76	Acre	$1,000.00	$162,760
Subtotal					$24,402,024
Severance Damage (10%)					$2,440,202
Total Value					$26,842,226
Estimated Compensation to Property Owner 90% (Rounded)					$24,158,004

Temporary Construction Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Land		542.98	Acre	$1,000.00	$542,980
Subtotal					$542,980
Severance Damage (10%)					$54,298
Total Value					$597,278
Estimated Compensation to Property Owner 80% (Rounded)					$477,823

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA	UNIT TYPE	UNIT PRICE	TOTAL
Warehouse	1	16,263.00	SF	$30.00	$487,890
Subtotal					$487,890
Severance Damage (10%)					$48,789
Total Value					$536,679
Estimated Compensation to Property Owner 90% (Rounded)					$483,012

Sub-Total Lands and Damages		$28,796,334
Contingencies (25%)		$7,199,084
Total Lands and Damages	01R1	$35,995,418

B. Acquisition Cost (Based on 80 Tracts from 41 Ownerships)

Project Planning	01A	$24,800
Acquisition	01B	$554,660
Condemnations	01C	$124,000
Appraisals	01E	$286,140
PL 91-646	01F	$199,000
Permits	01G	$12,000
Project Administration	01M	$171,000
Utility Relocations	01N	$25,000
Sub-Total		$1,396,600
Contingencies (25%)		$349,150
Total Acquisition Costs		$1,745,750

C. Public Law 91-646

Title II		$1,350,000
Title III		$12,000
Sub-Total		$1,362,000
Contingencies (25%)		$340,500
Total P.L. 91-646 Costs	01R2	$1,702,500

D. **Total Segment No. 2 Estimated Real Estate Costs** **$39,443,668**

SEGMENT No. 3 (Weir No. 1 to Weir No.2)

A. Lands and Damages

Fee Simple

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA OR AREA	UNIT TYPE	UNIT PRICE	TOTAL
Industrial Land		0.95	Acre	$30,000.00	$28,500
Low Frequently Flooded Land		288.32	Acre	$1,000.00	$288,320
Subtotal					$316,820

Severance Damage (10%)		$31,682
Total Value		$348,502
Estimated Compensation to Property Owner 100% (Rounded)		$348,502

Flowage Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA	UNIT TYPE	UNIT PRICE	TOTAL
Industrial Land		2.83	Acre	$30,000.00	$84,900
Low Frequently Flooded Land		23.36	Acre	$1,000.00	$23,360
Subtotal					$108,260
Severance Damage (10%)					$10,826
Total Value					$119,086
Estimated Compensation to Property Owner 90% (Rounded)					$107,177

Temporary Construction Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Land		6.87	Acre	$1,000.00	$6,870
Subtotal					$6,870
Severance Damage (10%)					$687
Total Value					$7,557
Estimated Compensation to Property Owner 80% (Rounded)					$6,046

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA (SF)	UNIT TYPE	UNIT PRICE	TOTAL
Industrial Land		0.91	Acre	$30,000.00	$27,300
Low Frequently Flooded Land		30.45	Acre	$1,000.00	$30,450
Subtotal					$57,750
Severance Damage (10%)					$5,775
Total Value					$63,525
Estimated Compensation to Property Owner 90% (Rounded)					$57,173

Sub-Total Lands and Damages		$518,898
Contingencies (25%)		$129,725
Total Lands and Damages	01R1	$648,623

B. Acquisition Cost (Based on 35 Tracts from 20 Ownerships)

Project Planning	01A	$24,800
Acquisition	01B	$216,075
Condemnations	01C	$61,000
Appraisals	01E	$164,855
PL 91-646	01F	$9,000
Permits	01G	$6,000
Project Administration	01M	$82,000

Utility Relocations	01N	$22,000
Sub-Total		$585,730
Contingencies (25%)		$146,433
Total Acquisition Costs		$732,163

C. Public Law 91-646

Title II	$0
Title III	$6,000
Sub-Total	$6,000
Contingencies (25%)	$1,500
Total P.L. 91-646 Costs 01R2	$7,500

D. **Total Segment No. 3 Estimated Real Estate Costs** **$1,388,285**

SEGMENT No. 4 (Everything South of Weir No. 2)

A. Lands and Damages

Fee Simple

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA OR AREA	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Land		55.27	Acre	No Value	$0
Low Frequently Flooded Land		19.79	Acre	$1,000.00	$19,790
Subtotal					$19,790
Severance Damage (10%)					$1,979
Total Value					$21,769
Estimated Compensation to Property Owner 100% (Rounded)					$21,769

Flowage Easement

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA OR AREA	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Land		11.35	Acre	$1,000.00	$11,350
Subtotal					$11,350
Severance Damage (10%)					$1,135
Total Value					$12,485
Estimated Compensation to Property Owner 90% (Rounded)					$11,236

Flood Protection Levee & Borrow Easements

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA OR AREA	UNIT TYPE	UNIT PRICE	TOTAL
Single Family Residence (*)	2	2,339.00	SF	$90.00	$421,020
Warehouse	3	11,413.00	SF	$30.00	$1,027,170
Industrial Land		31.37	Acre	$30,000.00	$941,100
Low Frequently Flooded Land		274.93	Acre	$1,000.00	$274,930
Subtotal					$2,664,220
Severance Damage (10%)					$266,422

Total Value		$2,930,642
Estimated Compensation to Property Owner 90% (Rounded)		$2,637,578
Sub-Total Lands and Damages		$2,670,583
Contingencies (25%)		$667,646
Total Lands and Damages	01R1	$3,338,229

B. Acquisition Cost (Based on 40 Tracts from 24 Ownerships)

Project Planning	01A	$24,800
Acquisition	01B	$263,340
Condemnations	01C	$73,000
Appraisals	01E	$185,680
PL 91-646	01F	$24,000
Permits	01G	$7,000
Project Administration	01M	$90,000
Utility Relocations	01N	$5,000
Sub-Total		$672,820
Contingencies (25%)		$168,205
Total Acquisition Costs		$841,025

C. Public Law 91-646

Title II		$120,000
Title III		$7,000
Sub-Total		$127,000
Contingencies (25%)		$31,750
Total P.L. 91-646 Costs	01R2	$158,750

D. **Total Segment No. 4 Estimated Real Estate Costs** **$4,338,004**

SEGMENT No. 5 (Mitigation)

A. Lands and Damages

Fee Simple

PROPERTY TYPE	NUMBER	AVERAGE GROSS AREA OF AREA	UNIT TYPE	UNIT PRICE	TOTAL
Low Frequently Flooded Land		8,080.00	Acre	$1,000.00	$8,080,000
Total Value					$8,080,000
Sub-Total Lands and Damages					$8,080,000
Contingencies (25%)					$2,020,000
Total Lands and Damages	01R1				$10,100,000

B. Acquisition Cost (Based on 20 Tracts from 20 Ownerships)

Project Planning	01A	$24,800
Acquisition	01B	$234,075

Condemnations	01C	$0
Appraisals	01E	$144,855
PL 91-646	01F	$9,000
Permits	01G	$6,000
Project Administration	01M	$59,000
Utility Relocations	01N	$0
Sub-Total		$477,730
Contingencies (25%)		$119,433
Total Acquisition Costs		$597,163

C. Public Law 91-646

Title II		$0
Title III		$6,000
Sub-Total		$6,000
Contingencies (25%)		$1,500
Total P.L. 91-646 Costs	01R2	$7,500

D. **Total Contract No. 5 Estimated Real Estate Costs** **$10,704,663**

(*) Land/Lot/Acres included in price.

PROJECT SUMMARY

BY CONTRACT

Segment 1	$118,692,077
Segment 2	$39,443,668
Segment 3	$1,388,285
Segment 4	$4,338,004
Segment 5 (Mitigation)	$10,704,663
Project Total	**$174,566,697**

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

PROJECT NAME: LeFleur Lakes Project
LOCAL SPONSOR: Rankin-Hinds Pearl River Flood and Drainage Control District

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purpose? (Yes/No)
b. Does the sponsor have the power of eminent domain for this project? ..... (Yes/No)
c. Does the sponsor have "quick-take" authority for this project? ..... (Yes/No)
d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? ..... (Yes/No)
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? ..... (Yes/No)

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? .....**SEE NOTE 1** ..... (Yes/No)
b. If the answer to II.a. is "yes", has a reasonable plan been developed to provide such training? N/A (Yes/No)
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? ..... **SEE NOTE 2** ..... (Yes/No)
d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? .....**SEE NOTE 2** ..... (Yes/No)
e. Can the sponsor obtain contractor support, if required, in a timely fashion? ..... (Yes/No)
f. Will the sponsor likely request USACE assistance in acquiring real estate? ..... (Yes/No)
(If "yes", provide description).

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? ..... (Yes/No)
b. Has the sponsor approved the project/real estate schedule/milestones? ..... (Yes/No)

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? ..... (Yes/No/Not applicable)
b. With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable. (If sponsor is believed to be "insufficiently capable", provide explanation).

V. Coordination

a. Has this assessment been coordinated with the sponsor? ..... (Yes/No)
b. Does the sponsor concur with this assessment? ..... (Yes/No)
(If "no", provide explanation).

Prepared by:

Bill Mayfield
Realty Specialist

26 Sept 2006
Date

Reviewed and approved by:

Burke S. Torrey
Chief, Real Estate Division

26 Sept 2006
Date

NOTE 1 – Local Sponsor has indicated that real estate acquisition to include P.L. 91-646 will be contracted.

NOTE 2 – Sponsor has indicated that all real estate acquisition will be contracted.

Exhibit TTT

APPENDIX 6

ECONOMIC ANALYSIS

PEARL RIVER WATERSHED
FEASIBILITY REPORT

APPENDIX 6
ECONOMIC ANALYSIS

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APPENDIX 6
ECONOMIC ANALYSIS

SECTION 1 - INTRODUCTION

1. The purpose the Pearl River Watershed study is to reevaluate the flood threat from the Pearl River in the Jackson Metropolitan Area of Jackson, Mississippi, and investigate two alternative flood control measures that have been proposed as potential solutions to flooding in the area.

2. This appendix will present a comparison of the economic flood damage results between the Comprehensive Levee Plan (i.e., the Recommended Plan from the 1996 U.S. Army Corps of Engineers feasibility analysis) and the locally proposed LeFleur Lakes Plan. The results will be displayed to describe the flood damage impacts, flood damages and losses, and potential benefits in addressing the economic feasibility of the two plans in an effort to determine if there is a continued Federal interest in participating in a flood control project in the area.

3. The overall objective is to evaluate each flood damage plan to determine if it is economically feasible, engineeringly implementable, environmentally sustainable, locally acceptable, and in the Federal interest.

4. The economic analysis is based on overbank flood profiles projected within the Pearl River Watershed study area defined by the 300-year flood frequency flowline from the Pearl River in the Jackson Metropolitan Area. The study area includes the municipalities of Jackson, Flowood, Pearl, and Richland.

SECTION 2 –THE CURRENT ALTERNATIVES

5. This section will describe a brief history of how the current flood control alternatives originated. As previously mentioned, the two plans considered for this analysis are the Comprehensive Levee Plan and the LeFleur Lakes Plan. A detailed description of each alternative is presented in the Main Report.

THE COMPREHENSIVE LEVEE PLAN

6. The Pearl River Watershed study area (displayed on Plate 2 of the Main Report) comprises that portion of the Jackson Metropolitan Area encompassing the Pearl River flood plain along a 30-mile stretch of the river in Hinds, Rankin, and Madison Counties. The Comprehensive Levee Plan (i.e., the Recommended Plan from the Jackson Metropolitan Area, Jackson, Mississippi, Draft Feasibility Report, January 1996) consists of a comprehensive levee system along the Pearl River from the dam of the Ross Barnett Reservoir near River Mile (RM) 301.77 downstream to RM 270.0 south of the town of Byram. The levee system alternative consists of raising 10.5 miles of the existing Fairgrounds and East Jackson levees from 2 to 6 feet as well as constructing approximately 21.9 miles of new levees to provide flood protection against the flood of record (the 1979 flood). The net grade of the Comprehensive Levee Plan, with a stage of 47.0 feet, National Geodetic Vertical Datum (NGVD), is equivalent to the Pearl River

flowline at the Highway 80 gage. Other features of the levee plan include 3,270 feet of floodwall, 10 gated box structures, 9 gated pipe structures, 242 acres of floodway clearing, 1,228 acres of reforestation for mitigation, and the acquisition/demolition of 28 commercial structures. Plate 3 of the Main Report shows the location of the existing and recommended levees.

7. Based on the results of the 1996 economic analysis, the Comprehensive Levee Plan would have a 99 percent probability of containing a 1 percent chance flood (100-year event) and would reduce 95 percent of total flood damages in the Pearl River Watershed study area. Of more particular importance, the Comprehensive Levee Plan would have a 96 percent probability of containing a 300-year event, should it occur. The results of the 1996 economic analysis of the Recommended Plan (shown in the following tabulation) are based on October 1994 price levels, a Federal interest rate of 7-3/4 percent, and a 100-year project life.

First Cost ($000)	Annual Cost ($000)	Annual Benefits ($000)	Excess Benefits ($000)	Benefit-Cost Ratio
99,379	9,098	13,912	4,814	1.53

8. The Pearl River Basin Development District (PRBDD) was the local sponsor during the feasibility phase of the 1996 study. However, the feasibility report was never completed due to the sponsor's inability to gain sufficient support to acquire funding. The 1996 draft report was shelved (set aside) due to lack of local support for the 1996 Recommended Plan. Furthermore, questions over the project's impact on the operation of the Ross Barnett Reservoir and concerns over potential flooding and bank caving in communities downstream of the Jackson Metropolitan Area were also primary issues impeding project support.

THE LEFLEUR LAKES PLAN

9. In 1996, local interests proposed the Two Lakes Plan as an alternative to the Comprehensive Levee Plan from the 1996 Corps report. Currently referred to as the LeFleur Lakes Plan, this alternative consists of an upper and a lower lake along the Pearl River that would extend from the Ross Barnett Reservoir outlet downstream to approximately 3 miles southwest of Interstate 20. In order to construct the lakes, the plan proposed major channel work, including cut and fill operations of the Pearl River, which would also create adjoining flood-free land available for commercial development. Both lakes combined cover approximately 4,800 acres (4,300 acres for the upper lake and 500 acres for the lower lake) at normal operating levels.

Weirs at both the upper and lower lakes would regulate flow. The Two Lakes Plan has gained considerable local support from community and business leaders due to its commercial development capabilities and potential for cost recovery.

10. An independent flood damage evaluation of the Two Lakes Plan was conducted through resources of local interests. Results of their analysis indicated that the Two Lakes Plan could be quite effective in reducing flooding from the Pearl River in the Jackson Metropolitan Area and provide flood damage reduction comparable to the Comprehensive Levee Plan. However, based on the review of the independent analysis and previous studies conducted for flood control in the study area, the Corps concluded that the Two Lakes Plan, as formulated, would be too costly. Since it would not be economically feasible under current Corps criteria, it was not recommended for Federal participation. Nevertheless, in conclusion to these findings, the Corps proposed a consensus between all interests in the resumption of the feasibility study process to examine all potentially feasible alternatives that would be acceptable to all parties.

THE CONSENSUS TO REEVALUATE THE TWO PLANS

11. Consensus meetings were held between PRBDD and the Rankin-Hinds Pearl River Flood and Drainage Control District (RHPRFDCD) in September 2001 to discuss resumption of flood control studies directed toward developing a compromise flood control plan that would

incorporate features of both the levee and lakes plans. The goal was to create a comprehensive plan that would integrate the features of both plans in combination with their project purposes to identify the best plan in accordance with the following qualifications: degree of flood protection, economic feasibility, environmental sustainability, and local acceptability. As a result of these meetings, the current LeFleur Lakes Plan was modified to consist of features from the "lakes plan" extending from the Ross Barnett Reservoir outlet downstream to near RM 284.0 and features from the "levee plan" to include upgrading the existing Fairgrounds and East Jackson levees and the construction of three new levee segments--the Town and Lynch Creek levee, the South Jackson levee, and the Richland levee. Features of the modified LeFleur Lakes Plan are discussed in more detail and displayed on Plate 4 of the Main Report.

SECTION 3 – OVERVIEW OF THE CURRENT ANALYSIS

12. Damage and benefit evaluations are based on current hydrologic analyses, land use and survey data, detailed cost data, extensive engineering and economic technical data, and other current factual data including risk-based procedures incorporated into the various economic evaluations. Factual data and computations describe the evaluation methodology utilized in determining annual benefits/costs for the improvements proposed.

13. Background data consist of a description of the flood plain, discussion of properties affected by flooding, and discussion of benefits/impacts associated with the two plans of improvement considered and evaluated, including appropriate risk-based analyses for specific parameters.

ECONOMIC RESULTS OF THE CURRENT ANALYSIS

14. Based on the results of the current economic analysis, presented in Table 6-1, total annual benefits for the Comprehensive Levee Plan are estimated at $14.0 million as compared to $16.1 million for the LeFleur Lakes Plan. As indicated, however, costs for the Lakes Plan are

significantly higher than those of the Levee Plan. Nonetheless, both plans afford a favorable degree of protection with approximately 79 and 91 percent in flood damage reduction for the Levee Plan and the Lakes Plan, respectively.

TABLE 6-1
SUMMARY OF THE CURRENT ECONOMIC ANALYSIS a/

Item	Comprehensive Levee Plan ($) b/	LeFleur Lakes Plan ($) c/
First Costs	205,765,000	1,428,777,000
Annual Costs	11,832,000	84,951,000
Annual Benefits	13,981,000	16,052,000
Excess Benefits-Over-Costs	2,149,000	-68,899,000
Benefit-Cost Ratio	1.18	0.19
Flood Damage Reduction	79 %	91 %

a/ Benefits and costs were rounded to the nearest thousand and annualized using a 50-year economic project life, the current Federal interest rate of 4-7/8 percent, and 2006 price levels.
b/ Costs of the Levee Plan were annualized using a 4-year period of construction and a project completion date of 2013.
c/ Costs of the Lakes Plan were annualized using an 8-year period of construction and a project completion date of 2018.

15. Resulting benefit-cost ratios from the analysis show the Comprehensive Levee Plan to be the most cost effective. The Levee Plan yields a benefit-cost ratio of 1.18 to 1 and excess benefits-over-costs of $2.1 million. The analysis of the Lakes Plan results in a benefit-cost ratio of 0.19 to 1 and a loss in "excess benefits" of -$68.9 million.

SECTION 4 - ECONOMIC FLOOD DAMAGE SETTING

16. The study area is primarily affected by headwater flooding from the Pearl River which is caused by heavy and intense rainfall over the upper Pearl River Basin. Floodwater from the Pearl River contains large amounts of silt and the larger floods that have occurred in the Jackson area have had durations of up to 2 weeks. Although flood control improvements have been implemented in the past, many areas of development in the Jackson Metropolitan Area still experience urban flood problems due to the inability of these areas to drain intense rainfall runoff through the tributary system. Commercial and residential structures and related development within and adjacent to the Pearl River flood plain are subjected to significant flood damages and losses from high stages on the Pearl River and its tributaries.

FLOOD HISTORY

17. Prior to 1979, the flood of record was the 1902 flood. The previous modern day flood of record occurred in 1961. These record floods were far surpassed as to flood levels, discharge, and damage by the event of 1979, the worst flood in Jackson's history, and by that of May 1983, another major, damaging flood. Because of the severity of these two floods, other floods which occurred between 1979 and 1983 are noted less frequently. Floods with frequencies of 5 to

10 years occurred on 21 March 1980, 14-17 April 1981, 6 December 1982, and 8-9 April 1983. This repeated flooding over the 4-year period caused a great deal of trauma to the citizens in the flood area and, combined with other events, has created intense interest in flood control.

18. During the 1979 flood, there were 1,935 houses and 775 businesses flooded. Damages to these properties were especially severe because the river was above flood stage from 10 to 14 days in some areas. This caused serious disruption to transportation and communications and stymied the capitol city for weeks. The total physical property damage caused by the 1979 flood was estimated at $233 million in 1979 dollars, or approximately $593 million in current dollars.

19. In a 2-day period between 12-13 April 1979, rainfall in amounts measuring up to 19.6 inches fell over the headwaters of the Basin. The resulting flood had an observed of 128,000 cubic feet per second (cfs) at the gage in Jackson. The resulting impact to Jackson was devastating. In May 1983, another severe rainfall in the upper Basin generated a peak of 78,600 cfs at the Jackson gage. The frequency of the 1979 and 1983 flood events is estimated to be 200 and 35 years, respectively, at the Jackson gage.

THE PEARL RIVER WATERSHED STUDY AREA

20. For this analysis, the study area is the area directly affected by the construction of water resources improvement plans in the Jackson Metropolitan Area of the Pearl River Watershed. It encompasses approximately 58,000 acres extending from the dam of Ross Barnett Reservoir downstream to the vicinity of Byram. Flood problems in the Pearl River Watershed study area impact portions of three counties in west-central Mississippi (Madison, Hinds, and Rankin) and four major municipalities (Jackson, Flowood, Pearl, and Richland).

21. Physiography in the Jackson Metropolitan Area typically ranges from flat flood plains to sloping areas up to 300 feet, NGVD. The study area is characterized by ample supplies of water resources which include lakes, swamps, rivers, bayous, and other tributary systems. Rainfall in the area is normally abundant and well distributed throughout the year, resulting in a fairly high water table. Annual precipitation ranges from 55.4 to 61.9 inches. Evaporation potential and permeability of the soils in the areas are normally moderate which result in soils that are somewhat poorly drained; dependent on the type of soil and season of the year. Development in

these areas usually has poor potential for most urban uses because of its susceptibility to flooding and wetness. Because of the mild climate and high water table, most structures built in these areas are constructed with a foundation depth of about 18 inches and do not have basements.

22. The Pearl River provides drainage to the entire project area. Among its numerous tributaries are Caney Creek, Conway Slough, Creosote Slough, Eubanks Creek, Hanging Moss Creek, Hardy Creek, Hog Creek, Lynch Creek, Neely Creek, Prairie Branch, Purple Creek, Richland Creek, Squirrel Branch, Steamboat Bayou, Three Mile Creek, and Town Creek. The total drainage area of the Pearl River in the project area covers approximately 91 square miles (see Plate 2 of the Main Report).

HYDROLOGIC FLOOD DAMAGE REACHES

23. For this analysis, the hydrologic reaches evaluated in the 1996 analysis were grouped into flood damage area/reaches according to their location or specific project feature to simplify the computation of data and inferences about the data. Plates 6-1 and 6-2 exhibit the Pearl River Watershed project area and all of the hydrologic reaches evaluated in this economic flood damage evaluation.

24. In the initial 1996 study, there were a total of 24 hydrologic reaches. These consisted of 17 reaches protected by new levees, 2 reaches protected by raising existing levees, and 5 river reaches in the unprotected areas between the levees. These reaches were determined based on hydrologic/hydraulic and economic conditions. Reach boundaries and levee alignments were also established to protect existing development with the minimum amount of construction with the least amount of environmental disturbance as possible.

SECTION 5 – URBAN FLOOD DAMAGE ANALYSIS

25. This section describes the urban flood damage evaluation of proposed water resource improvements in the Jackson Metropolitan Area of the Pearl River Watershed. The basic parameters of the economic analysis include 2006 price levels, an interest rate of 4-7/8 percent, and a 50-year project life. Background data consist of a description of the impacted area, a discussion of the number of properties and various categories of urban damage affected by flooding, and a narrative of the methodology used to determine the economic flood damages from which project benefits are derived.

26. The economic evaluation of urban flood damages in the project area included the comparison of the flood damage setting for "without-project" and "with-project" conditions for each alternative plan in determining project benefits. The without-project conditions, or existing conditions, for this analysis reflect the conditions expected to prevail in the absence of any alternative plan of improvement. It is the same as the alternative of "no action." The with-project conditions reflect conditions in the area when a selected alternative to alleviate flooding problems is in place.

URBAN BENEFIT CONSIDERATIONS

27. The National Economic Development (NED) Procedures Manual for Urban Flood Damage recognizes four primary categories of benefits for urban flood control plans: inundation reduction, intensification, location, and employment benefits. Inundation reduction is the only category of NED benefits for urban areas considered in this analysis. This category includes damages to residential and nonresidential structures, losses to the contents in those structures, damages to privately owned automobiles, damages to roads and bridges, damages to utilities (such as the municipal wastewater treatment facility in the Pearl River Watershed study area), the additional costs associated with conducting emergency operations, and Federal Insurance Administration (FIA) costs.

RISK CONSIDERATIONS

28. Expected flood damages for existing conditions and with proposed flood control measures in place were considered utilizing the risk and uncertainty guidance in Engineer Circular (EC) 1105-2-100, "Planning Guidance Notebook" (22 April 2000); Engineer Regulation (ER) 1105-2-101, "Planning - Risk Analysis for Flood Damage Reduction Studies" (3 January 2006); and EC 1105-2-205, "Risk Analysis Framework for Evaluation of Hydrology/Hydraulics

and Economics in Flood Damage Reduction Studies" (25 February 1994). The specific purpose of this analysis was to determine the feasibility of providing flood protection to the area and quantify the uncertainty associated with making the decision to invest in a flood protection project in the Jackson Metropolitan Area. This component of the analysis was accomplished utilizing the Hydrologic Engineering Center Next Generation Flood Damage Analysis (HEC-FDA) computer program which is discussed in more detail in Section 6.

THE EXISTING URBAN ENVIRONMENT

29. The urban flood damage analysis of the Pearl River Watershed project area involved the identification and evaluation of several categories of flood losses associated with urban development. Existing (without-project) and with-project urban flood damages and impacts will be presented and discussed in this section.

30. In the absence of flood control measures in the project area, various types of damages and losses are incurred as a result of flooding in and around urbanized development. These include damages to homes and businesses, losses to the contents of structures, flood damages to automobiles, road and bridge damages, flood damages to the Savanna Street Wastewater

Treatment Plant (SSWWTP) in south Jackson, emergency costs during flood operations, and the cost of administering flood insurance. Most of these damages and costs are directly related to the number of structures flooded by flood frequency and some are not.

ECONOMIC FLOOD DAMAGE REACHES

31. For the purposes of this study, the original 24 reaches of the 1996 study were grouped or combined into 5 areas of economic flood damage reaches based on various conditions (e.g., some of the areas are existing levee areas, some have particular hydrologic concerns, some are unprotected riverside areas, etc.). The economic flood damage reaches for the current evaluation are displayed in Table 6-2 by area. Table 6-2 also includes the total estimated number of structures located in each reach of the study area and the total estimated number of structures impacted by flooding at the 100-year flood frequency elevation.

TABLE 6-2
ECONOMIC FLOOD DAMAGE REACHES
WITH ESTIMATED NUMBER OF STRUCTURES LOCATED IN EACH REACH
AND ESTIMATED NUMBER OF STRUCTURES IMPACTED BY FLOODING AT THE 100-YEAR EVENT
EXISTING CONDITIONS

Area	Original Reach	Existing Number of Structures a/					
		Located in the Area			Damaged at the 100-Year Frequency Flood b/		
		Res	Nonres	Total	Res	Nonres	Total
Existing Levee Areas							
Fairgrounds	W4	47	154	201	0	0	0
East Jackson	E2	1,703	511	2,214	0	0	0
Town and Lynch Creek Areas							
Town & Lynch	W5, W6	448	569	1,017	154	289	443
Richland and South Jackson Areas							
South Jackson	W7, W8	493	97	590	21	2	23
Richland	E3	447	139	586	200	50	250
Above Existing Levee Areas							
Northeast Jackson	W1, W2	3,355	325	3,680	1,637	76	1,713
Flowood & Laurelwood	E1, E1A, RE1	322	237	559	232	108	340
Floodwall & Vicinity	W3	258	61	319	73	35	108
Unprotected Areas							
River Reaches	RW1, RW1A, RW2, RW2A, RW3R	377	40	417	229	28	257
Total	--	7,450	2,133	9,583	2,546	588	3,134

a/ Res = Residential (houses, mobile homes, and apartments); Nonres = Nonresidential (commercial, professional, public, semipublic, industrial, recreational, and warehouses).
b/ HEC-FDA results comparable to results of the 1996 analysis.

THE EXISTING STRUCTURE EVALUATION

32. In the initiation of urban flood damage analyses, field investigations were conducted and data were collected to identify the extent and character of flooding in the project area for existing (current) conditions. The determination of existing urban flood damages was based on the integration of depth-damage relationships and flood frequency distributions to the structures located in the area. Development of the existing structural database was dependent upon the examination of aerial photographs and hydrologic data and a compilation of field survey data. The use of applicable flood damage analysis curves was used to depict the relationships between the stage and area inundated, stage and frequency of occurrence, stage and damage, and damage and frequency of occurrence.

STRUCTURE INVENTORY

33. The existing urban flood damages were determined utilizing the comprehensive structural database developed for the 1996 analysis which was updated in 2006 to account for new development. The original database included on complete onsite structural surveys conducted in 1987, 1989, 1991, and 1996. The additional windshield inventory was performed in the spring

of 2006 to identify all new construction that had occurred since the previous inventories. Information gathered on each structure consisted of value, structure type, first-floor elevation (FFE), type of construction, type of foundation, number of stories, physical condition, size in dimensions, age, and location. The comprehensive survey, as opposed to a sample, and highly detailed data it produced were critical to this evaluation and enhance the accuracy of the study findings.

34. Based on these surveys, the study area consists of an estimated 9,583 structures, including 7,450 residential and 2,133 nonresidential properties, or 78 and 22 percent of total structures, respectively. The total number of urban structures located in the study area by reach is presented in Table 6-2 for existing conditions. It should be noted that although all of the structures are located in the study area, not all of these structures are subject to flooding.

STRUCTURES IMPACTED
BY FLOOD FREQUENCY

35. Table 6-2 also presents the number of structures impacted in the study area by frequency flood event. An estimated total of 3,134 structures were identified to be subject to flooding from a 100-year frequency flood event, including 2,546 residences (81 percent) and 588 nonresidential

buildings (19 percent). Residential structures affected by flooding include houses, apartments, and mobile homes. Nonresidential development susceptible to flooding includes retail (commercial) and services (professional) buildings, industrial structures, public and semipublic buildings, and warehouses. The HEC-FDA program, inclusive of risk considerations, was used to determine flood damages by flood frequencies to urban properties in the Pearl River Watershed study area in accordance with ECs 1105-2-100 and 1105-2-101.

STRUCTURES AND CONTENTS VALUES

36. Structure and contents values are major elements influencing the impact of depth-damage relationships and magnitude of flood damages to urban structures. Real estate appraisers for the Vicksburg District determined the values associated with the majority of the structures in the project area whereby each structure was visually evaluated. Depreciated replacement values were used in estimating the correct measure of structure values for this analysis. For the purposes of estimating urban flood damages, a structure is defined as a building and any attached components, such as built-in appliances, shelves, carpeting, etc. The value of land is excluded in the determination of urban structure values. Structure values of development in the area since 1996 were derived utilizing the Marshall and Swift Valuation Service (M&S) to calculate the depreciated cost for residential and nonresidential structures. The M&S, who has been a leading provider of building cost data in the real estate industry since 1932, has been a recommended and

approved source of real estate valuation for the Corps for over the past 10 years. For this study, M&S building cost data are used to develop replacement costs, depreciation values, and insurable values of buildings and other improvements impacted by flooding in the project area.

37. In determining flood damages to contents, contents represent the furnishings and equipment of a structure or all items within the structure that are not permanently attached. For this analysis, contents-to-structure value ratios (CSVR) were taken from the Generic Depth-Damage Relationships provided for Corps flood damage and flood control studies as directed by the Flood Damage Data Collection Program (FDDCP) in Economic Guidance Memorandum (EGM) 04-01, "Generic Depth-Damage Relationships." The primary purpose of FDDCP is to meet the requirement by providing Corps District offices with standardized relationships for estimating flood damages and other costs of flooding based on actual losses from flood events. Under this program, the Generic Depth-Damage Relationships and corresponding CSVRs developed in this analysis are based on data collected nationwide since 1996. The CSVRs were developed for 11 structure categories--5 residential and 6 nonresidential structure classifications. The CSVRs developed for the each structure category in the project area are shown in Table 6-3.

TABLE 6-3
CONTENTS-TO-STRUCTURE VALUE RATIOS a/

Structure Type	CSVR (%)
Residential	
1-story	100
2-story	100
Nonresidential	
Retail (Commercial)	125
Services (Professional)	125
Public	24
Semipublic	24
Industrial	113
Warehouse	125

a/ CSVRs from EGM 04-01.

STRUCTURE ELEVATIONS

38. Structure elevations were derived from third order surveys using conventional levels for 55 percent of the structures. Approximately 45 percent of the structure elevations were derived from 2-foot contour aerial survey mapping.

39. Using computer analyses, FFEs of structures are correlated with depth-damage factors and hydrologic data to calculate the expected flood depths to each structure for each set of hydrologic conditions. The resulting damages by each frequency were used to determine the existing average or expected annual urban flood damages for each reach. This process was applied for

both without- and with-project conditions in determining the number of structures flooded by frequency. Table 6-4 displays the number of structures damaged by flood frequency of occurrence. Of particular importance is the magnitude of structures subject to flood damages from the 25-year event and greater for existing conditions.

TABLE 6-4
TOTAL NUMBER OF STRUCTURES IMPACTED AND
STRUCTURE FLOOD DAMAGES BY FREQUENCY OF FLOODING
EXISTING CONDITIONS

Frequency of Occurrence (Freq/Yr)	Number of Structures Impacted (No.) a/			Existing Structure Flood Damages ($000) b/		
	Res	Nonres	Total	Res	Nonres	Total
1	0	0	0	0.0	0.0	0.0
2	1	0	1	0.6	0.0	0.6
5	7	13	20	7.6	330.5	338.1
10	232	60	292	886.5	1,460.3	2,346.9
25	1,071	182	1,253	15,397.4	12,968.1	28,365.5
50	1,722	419	2,141	51,174.3	67,344.5	118,518.8
100	2,546	588	3,134	98,716.3	189,555.2	288,271.5
500	4,989	1,208	6,197	222,494.6	516,969.3	739,463.9

a/ Res = Residential; Nonres = Nonresidential.
b/ HEC-FDA output presented in 2006 dollars.

40. The number of structures impacted by flood frequency is also used to quantify other types of urban flood damage. These include flood damages to automobiles, the reduction in flood costs associated with emergency operations, and the administration of flood insurance (FIA). Damage/cost factors associated with each category are correlated with the number of structures flooded by frequency to calculate their relative impacts by flood frequency.

DEPTH-DAMAGE RELATIONSHIPS

41. Generic Depth-Damage Relationships provided in guidance EGM 04-01 were used to quantify the extent of flooding and urban flood damages in the project area. These curves were used to indicate the percentage of the total structure (and contents) value that would be damaged at various depths of flooding. Damage percentages were determined for each 1-foot increment from 2 feet below the first-floor elevation to 12 feet above the FFE of the structure.

STRUCTURE FLOOD DAMAGE EVALUATION

42. In quantifying the extent of existing flood impacts in the project area, HEC-FDA was used to correlate various structure types by their elevation to specific hydrologic conditions. Within the program, specific types of urban structures (along with contents) are evaluated using hydrologic profile data, structure alignments, FFEs, depth-damage relationships, and structure values to compute the damages for each structure for various frequency flood events. The resulting damage-frequency output is integrated with stage-frequency data to develop stage-damage curve relative to each area.

43. Table 6-4 shows that an estimated 6,197 structures are susceptible to flooding in the study area from the 500-year flood frequency event while 292 structures begin to flood at the 10-year event and 20 at the 5-year event. Structural flood damages at these frequencies equate to an estimated $739.5 million at the 500-year flood frequency, $2.3 million at the 25-year flood frequency, and $338,000 at the 5-year event.

44. The contribution to average annual flood damages from flooding events of a 100-year magnitude or greater is often relatively small, but this is not the case in the Jackson area. Based on the current analysis, 3,134 structures are impacted by flooding at the 100-year event with estimated damages of $288.3 million. Furthermore, results of the 1996 study show the contribution to average annual damages from floods ranging from a 100-year event through a Standard Project Flood (SPF) event to be approximately 62 percent of total average annual flood damages for existing conditions. This is in large part due to the protection afforded by the existing Fairgrounds and the East Jackson levee. This phenomenon is also true because of the degree of development of the upper portions of the flood plain relative to the development in the lower portions of the flood plain, particularly in the northeast and south Jackson areas. The results of this phenomenon make it imperative that potential solutions to the flooding problem address themselves primarily to substantial reduction of flood stages that occur from flood events greater than the 100-year event.

SECTION 6 – THE RISK-BASED ANALYSIS

45. According to Federal guidelines, the comprehensive evaluation of flood damages to structures and other properties in evaluating water resources projects requires additional risk-based analyses to account for any inherent uncertainty associated with the economic and hydrologic input variables of the analysis. Thus, urban flood damages for without- and with-project conditions for all identified flood damage categories evaluated in the Pearl River Watershed study area are accomplished utilizing the HEC-FDA program discussed in the following section.

RISK AND UNCERTAINTY IN WATER RESOURCES PLANNING

46. Even though every attempt is made to ensure accuracy, a degree of uncertainty is implicit in many areas of planning for water resource projects. The uncertainty arises due to error in the data being measured or errors inherent in the methods used to estimate the values of certain critical variables. The potential for error exists throughout the previous traditional analysis because each of the variables has been assigned a single point value rather than a range of values. In order to compensate for possible error, risk-based analysis can be applied to the planning and design of water resource projects. This approach, which quantifies the extent of systematic risk, provides the decisionmaker with a broader range of information. Thus, a decision can be made that reflects the explicit tradeoff between risks and costs.

THE HEC-FDA PROGRAM

47. The Corps requires the use of risk-based analysis procedures for formulating and evaluating flood damage reduction measures. The HEC-FDA is the interdisciplinary computer program that was utilized to evaluate flood damages in the project area using risk-based analysis. The risk-based approach to urban flood damage analysis incorporates elements of risk and uncertainty more directly into project formulation, evaluation, and design of alternatives in the analysis of flood inundation damages and hydrologic engineering performance for plan evaluations in accordance with Corps policy regulations ERs 1105-2-100 and 1105-2-101. Both economic flood damage and hydrologic engineering analyses are performed using a consistent study configuration (e.g., streams, damage reaches, plans, and analysis years). Two types of evaluation are available in the program—analysis of damage and project performance by analysis years and equivalent annual damage. The type of evaluation used for the project area was the analysis of damage and project performance by analysis years. More detailed information about the HEC-FDA program can be obtained from the following website:

http://www.hec.usace.army.mil/sofware/hec-fda/hecfda-hecfda.html

RISK METHODOLOGY

48. Risk-based analysis integrates risk and uncertainty into the computation of flood damages for specified events by using a simulation technique in which multiple iterations selected from a full range of possible values for each variable identified as a source of uncertainty. The analysis is accomplished by considering the range of possible values (maximum and minimum values for each input variable in the flood damage calculation) and distribution of the likely occurrence of outcomes over the specified range.

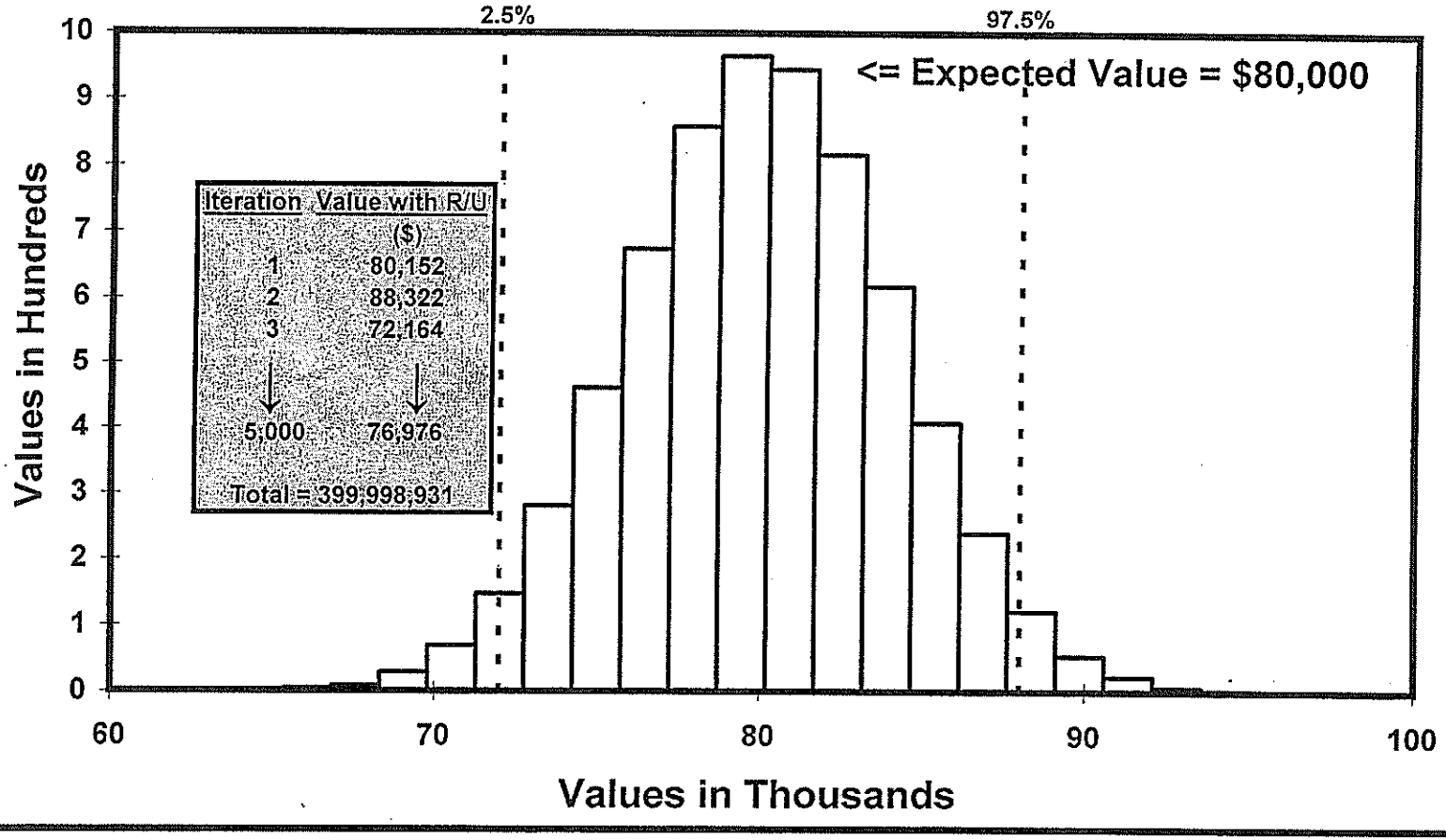
49. The HEC-FDA program uses inventories of flood plain structures to calculate stage-damage-uncertainty information at damage index locations. To compute the uncertainty or error surrounding the elevation- or stage-damage curves, a maximum and a minimum value for each economic variable (FFE, structure and content values, and depth-damage relationships) is input. The program also uses the number of years that stages were recorded at a given gage to determine the hydrologic uncertainty surrounding the stage-frequency curves. The possible occurrences of each variable were derived through the use of Monte Carlo simulation, which used randomly selected numbers to simulate the values of the selected variables from within the established ranges and distributions. For each variable, the computerized Latin Hypercube

sampling technique was used to sample from within the range of possible values. With each sample, or iteration, a different value was selected. The number of iterations performed affects the simulation execution time and the quality and accuracy of the results.

50. The sum of all sampled values divided by the number of samples yielded the expected value, or mean. This process was conducted simultaneously for each economic and hydrologic variable. The resulting mean value and probability distributions formed a comprehensive picture of all possible outcomes. Expected and/or equivalent annual damage is computed in the evaluation portion of HEC-FDA.

51. Figure 6-1 displays a schematic diagram example of the results of risk and uncertainty modeling from calculating the structure value for an individual residential structure. A normal distribution is depicted with a sample mean value of $80,000, standard deviation of 0.05102 (0.10/1.96), and a range plus or minus 10 percent. Assuming there is a 95 percent confidence level, the true mean is within +10 percent of the sample mean. This implies a standard deviation for structure values of $80,000 equals 8,000/1.96 or 4,082. The risk model not only evaluates the uncertainty of each variable in this manner, but integrates the uncertainty of all the variables.

Figure 6-1
Example
Structure Value Uncertainty
Pearl River Watershed, Mississippi



ECONOMIC PARAMETERS OF UNCERTAINTY

52. In the evaluation of urban flood damages in the Pearl River Watershed study area, risk-based analysis was performed on four key economic variables: structure values, contents-to-structure value ratios, FFEs, and depth-damage relationships. Each of these variables was analyzed for its impact on the elevation-damage curve. The HEC-FDA program calculates economic stage-damage with uncertainty; integrates the stage-damage curve, stage-discharge curve, and the discharge-probability curve; and will evaluate levees, channels, existing and proposed levees including project sizing and project reliability.

HYDROLOGIC PARAMETERS OF UNCERTAINTY

53. The Vicksburg District Hydraulics Branch provided stage-frequency curves for without- and with-project conditions. The stages for eight frequency storms (1-, 2-, 5-, 10-, 25-, 50-, 100-, and 500-year events) that were provided represent the entire range of frequency events between the 1- and 500-year frequency flood events. The stage-frequency data and FFE of the residential and nonresidential structures were used to determine the number of structures flooded in each reach for without- and with-project conditions. The Hydraulics Branch used an equivalent

record length of 43 years to determine the uncertainty associated with the stage-frequency data. Based on this equivalent record length, the program calculated the confidence limits surrounding the stage-frequency function. (Refer to Appendix 4 - Engineering Appendix - Hydraulics Section, for a more complete discussion.)

SECTION 7 - RISK-BASED URBAN FLOOD DAMAGE EVALUATION

STRUCTURE ANALYSIS

STRUCTURE RISK PARAMETERS

Structure Values

54. The two basic structural damage categories considered in the analysis include residential and nonresidential properties. Structure values determined by real estate appraisers or M&S rate a fairly high degree of accuracy. Thus, in calculating any possible error associated with the calculation of urban flood damages to structures, the uncertainty is represented by a TNORMAL probability density function with the appraised value representing the mean, a standard normal deviation, and a minimum value of the mean minus 10 percent and a maximum value of the mean minus 10 percent for residential structures. A TNORMAL probability density function is a normal distribution that is truncated at each end of the distribution by the limits of the range of possible values established. Nonresidential minimum and maximum were based on a 10 percent estimated error.

CSVR

55. Content-to-structure value ratios were obtained from the Generic Depth-Damage Relationships provided in EGM 04-01 as directed by the Institute of Water Resources (IWR) and are deemed to be very reliable. A TNORMAL probability density function was used with each content category and a standard deviation of 10 percent was calculated.

Structural FFE

56. Risk assessment of structure FFEs was based on estimates of error established in EC 1105-2-205. Structure elevations were derived by structure using conventional levels for 55 percent of the structures. Approximately 45 percent of the structure elevations were derived from 2-foot contour aerial survey mapping. The standard deviations in feet were 0.03 and 0.30 for conventional level and 2-foot aerial survey, respectively. A TNORMAL probability density function was used to describe this variable.

Depth-Damage Relationships

57. Generic depth-damage relationships were obtained from the generic depth-damage relationships provided in EGM 04-01 as directed to use by IWR. These curves were used to indicate the percentage of the total structure value that would be damaged from various depths of flooding. Damage percentages were determined for each 1-foot increment from 2 feet below the FFE to 12 feet above the FFE of the structure. A TNORMAL probability density function was used to determine the uncertainty associated with each increment of flooding and a standard deviation of 10 percent was calculated.

STRUCTURES DAMAGES
WITH UNCERTAINTY

58. Total expected annual structure damages were estimated to be $14.5 million (expressed in 2006 prices) for existing conditions in the Pearl River Watershed study area. These damages, expressed in 2006 prices, included the inherent risk and uncertainty associated with flood damages to urban residential and nonresidential properties in the Jackson Metropolitan Area.

With-project conditions yielded expected annual structure damages of $3.4 million for the Levee Plan (or 77 percent in flood damage reduction) and $1.5 million for the LeFleur Lakes Plan (or 90 percent in flood damage prevented).

AUTOMOBILE ANALYSIS

59. The analysis of automobile damages involved determining the number of units (automobiles) impacted and the application of these data to a damage per unit value. Estimation of the number of automobiles per household by frequency was accomplished utilizing the number of automobiles per household and the number of households assumed to be damaged in each area (from the HEC-FDA program). These values were applied to an average damage per automobile to derive overall damages.

60. Variations in the depth of flooding in these urban areas would result in some automobiles having a higher percentage of damage than others. Therefore, it was determined that the damage per automobile should be based on an average of several flood depths and represent potential average damage values. The average residence in the project area was assumed to have two automobiles per household (based on U.S. Census Statistics). Each of these automobiles was assigned a value of $15,000 based on a composite average value of used automobiles from J.D.Powers' Automobiles.com and local auto auctions (with a dealer markup).

61. In addition, considering the velocity flooding typical of the project area, only one-third of the affected automobiles was assumed to receive flood damages. Furthermore, it was assumed that each automobile was parked 0.5 foot below the elevation of slab houses (i.e., the water entry level) and 1.5 feet below the elevation of houses built on piers. No vehicles were assigned to commercial properties.

62. A TNORMAL probability density function was used to determine the uncertainty surrounding the values assigned to the automobiles in the inventory with a mean value of $9,893 (one-third of the average value of two automobiles) and a standard deviation of 10 percent.

AUTOMOBILE DAMAGES
WITH UNCERTAINTY

63. The expected annual damages to automobiles were estimated to be $569,500 for existing conditions. With project implementation, the expected annual damages to automobiles for the Comprehensive Levee Plan and the LeFleur Lakes Plan were estimated to be $204,800 and $60,600, respectively. These damages, expressed in 2006 prices, included the inherent risk and uncertainty associated with automobile flood damage.

EMERGENCY COST ANALYSIS

64. Emergency costs include such items as evacuation and reoccupation costs; flood-fighting expenses; costs for emergency shelter and food for evacuees; state and Federal disaster relief; increased expense of normal operations; increased costs of police, fire, and/or military patrol; and losses due to abnormal depreciation of equipment (e.g., fire trucks, patrol cars, bulldozers, etc.) resulting from catastrophic flooding. Specific flood-fighting activities include sandbagging, road barricades, pumps and associated equipment, levees, transport of fill dirt, etc., and other requirements resulting from flooding. These are expenses or costs borne by affected residents and property owners, local or state governments or agencies, and other Federal agencies or national organizations.

65. Emergency costs were calculated based on the number of structures flooded by frequency applied to an emergency cost value per structure of $1,112 for residential structures and $1,827 for nonresidential structures. This was based on a survey of prepared by Vicksburg District after the flood several floods in the 1990s. The number of structures affected was combined with the emergency cost per structure to develop the stage-damage relationship for each area.

66. A TNORMAL probability density function was used to determine the uncertainty surrounding the values assigned to cost of emergency flood-fighting operations, and a standard deviation of 10 percent was calculated.

EMERGENCY COSTS
WITH UNCERTAINTY

67. The HEC-FDA results calculated the expected annual emergency costs in the study area to be approximately $183,100 for existing conditions. These costs, expressed in 2006 prices, included the inherent risk and uncertainty associated with the cost of emergency operations. With project implementation, expected annual damages (or additional costs) to emergency operations were estimated to be $47,100 for the Comprehensive Levee Plan and $16,500 for the LeFleur Lakes Plan.

PUBLIC ROAD AND BRIDGE ANALYSIS

68. The overall analysis of transportation facility losses involved determining the number of units adversely impacted by frequency and the application of these data to a loss per unit value for various types of facilities involved. Aerial photographs, topographic maps, hydrologic data,

and a delineation of the area affected were utilized in this analysis. In order to calculate these damages, stage-frequency and stage-damage curves were developed for each area. The evaluation also incorporated data from interviews with local officials.

69. The type, location, and number of miles of streets, roads, etc., affected were based on analysis of current aerial photographs and topographic maps on which the impacted area was delineated. The loss value per mile of road was derived through contacts with the street maintenance personnel and county highway officials in the project area. These officials are very familiar with all aspects of highway/bridge construction, repair, and maintenance cost including those associated with historical flood damage. The county engineers evaluated actual cost estimates of asphalt overlay and minimum patching. A loss value of $48,856 per mile was estimated (expressed in 2006 dollars). The number of miles of roads flooded by the 50-, 100-, 300-, and 500-year events by levee segment area was derived by delineating these events onto quadrangle maps and planimetering highway mileage and applied to the loss value per mile to establish a stage-damage relationship. No road and bridge damages were calculated below the 50-year event. Although rerouting traffic costs have occurred from historical flood events, these costs were not included in this analysis.

PUBLIC ROAD AND BRIDGE DAMAGES

70. The expected annual damages to roads and bridges were estimated to be $89,100 for existing conditions. With project implementation, road and bridge damages for the Comprehensive Levee Plan and the LeFleur Lakes Plan were estimated to be $3,300 and $38,300, respectively. Risk and uncertainty procedures are not applied to road and bridge damages since they are based on reliable values provided by county engineers.

FEDERAL FLOOD INSURANCE ANALYSIS

71. The net national cost of the flood insurance program includes the costs of claims adjustment, agent commissions, and the cost of servicing the policies. Since fewer property owners will be in the 100-year flood plain and will be required to have flood insurance coverage, potential benefits attributable to the project will arise from a reduction in the administration overhead.

72. In order to determine the expected annual FIA costs, the HEC-FDA computer program was used to determine the number of residential structures within the 100-year flood plain under the without- and with-project conditions. The 100-year flood plain was defined as the number of

structures with an FFE equal to or less than the stage associated with a 100-year frequency storm event. The number of structures was then multiplied by the $192 average administrative cost per property and adjusted downward based on the percentage of properties covered by flood insurance.

73. Benefits accrued from the reduction in the cost of administering the flood insurance program deals with probable changes in the aerial extent of the 100-year flood plain for the without- versus with-project conditions. The number of structures participating in the program which would no longer be in the 100-year flood plain was used to compute these benefits based on a current operating cost per policy of $192 based on guidance provided by EGM 06-04, "NFIP (National Flood Insurance Program) Operating Costs FY 2006." Results of this analysis are provided in Table 6-5.

TABLE 6-5
TOTAL ANNUAL COSTS ASSOCIATED WITH FIA
EXISTING AND WITH-PROJECT CONDITIONS

Plan	Existing (Without-Project)		With-Project	
	Structures at 100-Year (No.)	FIA Costs ($) a/	Structures at 100-Year (No.)	FIA Costs ($) a/
Comprehensive Levee Plan	2,546	488,800	252	48,400
LeFleur Lakes Plan	2,546	488,800	36	6,900

a/ Costs (rounded to nearest hundred) derived from individual FIA policy cost of $192 for 2006.

FLOOD INSURANCE COSTS

74. Results of the FIA evaluation presented in Table 6-5 calculated the expected annual FIA costs in the project area to be approximately $488,800 for existing conditions. With project implementation, expected annual FIA costs were estimated to be $48,400 for the Comprehensive Levee Plan and $6,900 for the LeFleur Lakes Plan. Risk and uncertainty procedures are not applied to FIA savings since they are based on a fixed cost.

TREATMENT PLANT ANALYSIS

75. Flood damages and project benefits were determined for the SSWWTP between Hardy and Caney Creeks in the South Jackson area. The SSWWTP is the wastewater treatment facility for the Jackson Metropolitan Area serving the cities of Jackson, Flowood, Pearl, Richland, and Brandon. The treatment plant is currently protected by a non-Federal ring levee. Estimated without- and with-project damages and benefits were derived through field investigations and consultation with the city of Jackson Department of Public Works (JDPW) and SSWWTP personnel. The existing treatment plant levee was evaluated to determine the reliability of the levee and identify probable failure and nonfailure points. Flood damages were based on

beginning points of damages, estimated damages by flood elevation, historical flood damages, and probabilities of levee failures. The JDPW engineering staff estimated repair cost to SSWWTP as a result of a flood the magnitude of the 1979 flood would require $29.6 million (in 2006 dollars).

TREATMENT PLANT DAMAGES

76. Results of the treatment plant evaluation calculated the expected annual damages to the SSWWTP to be approximately $1.9 million for existing conditions. Flood damages would be reduced by 100 percent with the implementation of both the Comprehensive Levee Plan and the LeFleur Lakes Plan. Risk and uncertainty procedures are not applied to treatment plant damages since they are based on a fixed value provided by JDPW officials.

TOTAL URBAN FLOOD DAMAGES

EXPECTED ANNUAL
FLOOD DAMAGES

77. In the absence of flood control measures, damages will occur to urban properties, roads and bridges, and automobiles. Additionally, flood-related cost for emergency expenses and cost for administering the FIA program will occur. In the Pearl River Watershed study area, additional

damages occur to its municipal wastewater treatment facility in south Jackson. A summary of total expected annual urban flood damages is presented by category in Table 6-6 for existing and with-project conditions. Total existing damages in the study area are estimated to be approximately $17.7 million. Of this amount, nonresidential and residential structures comprise 53 and 29 percent, respectively, of the total expected urban annual damages, or 82 percent combined.

TABLE 6-6
SUMMARY OF EXPECTED ANNUAL URBAN FLOOD DAMAGES

Benefit Category	Annual Damages ($000) a/b/		
	Existing Conditions	Comprehensive Levee Plan	LeFleur Lakes Plan
Structures	14,478.1	3,379.1	1,488.8
Residential	5,112.0	823.4	321.5
Nonresidential	9,366.1	2,555.7	1,167.3
Automobiles	569.5	204.8	60.6
Emergency Costs	183.1	47.1	16.5
FIA Costs	488.8	48.4	6.9
Road and Bridge	89.1	3.3	38.3
Subtotal (excluding treatment plant)	15,808.6	3,682.7	1,611.2
Treatment Plant	1,855.0	0	0
TOTAL	17,663.6	3,682.7	1,611.2

a/ Values in 2006 dollars.
b/ Totals may not add to due rounding.

78. Total expected urban flood damages for existing conditions (i.e., without flood reduction measures in place) by flood damage area/reach are displayed in Table 6-7. According to these results, northeast Jackson experiences the majority of estimated flood damages (27 percent) from overbank flooding along the west side of the Pearl River.

TABLE 6-7
TOTAL EXPECTED ANNUAL URBAN FLOOD DAMAGES BY AREA
EXISTING CONDITIONS

Area	Total Urban Damages by Category ($000) a/b/								
	Urban Structures c/			Automobiles	Road and Bridge	Emergency Costs	FIA Cost	Treatment Plant	Total
	Res	Nonres	Total						
Existing Levee Areas									
Fairgrounds	5.4	367.7	373.1	0.5	10.8	1.0	0	0	385.4
East Jackson	134.4	443.6	578.0	26.3	23.6	5.9	0	0	633.8
Town & Lynch Creek Areas									
Town Creek	14.5	3,294.3	3,308.8	9.8	9.3	31.1	7.3	0	3,366.3
Lynch Creek	82.1	413.7	495.8	27.2	0.5	10.3	22.3	0	556.1
Richland & South Jackson Areas									
S. Jackson	107.1	102.4	209.5	16.6	2.6	7.4	4.0	1,855.0	2,094.8
Richland	301.9	401.2	703.1	62.1	3.9	20.5	38.4	0	828.0
Above Existing Levee Areas									
NE Jackson	3,692.8	410.7	4,103.5	263.0	16.4	69.0	314.3	0	4,766.2
Flowood and Laurelwood	286.2	3,098.7	3,384.9	28.9	15.1	14.4	44.5	0	3,487.6
Floodwall and Vicinity	146.8	565.6	712.4	10.8	3.6	4.6	14.0	0	745.4
Unprotected Areas									
River Reaches	340.8	268.1	608.9	124.3	3.3	19.3	44.0	0	799.8
Total	5,112.0	9,366.1	14,478.1	569.5	89.1	183.1	488.8	1,855.0	17,663.6

a/ Results of the HEC-FDA program in 2006 dollars.
b/ Totals may not round due to rounding.
c/ Res = Residential; Nonres = Nonresidential.

SECTION 8 – TOTAL PROJECT BENEFITS

79. With-project expected annual damages are subtracted from without-project expected annual damages in order to determine the project benefits to the study area with water resources improvement plans in place. This section will describe the resulting benefits/impacts associated with each of the two flood control alternatives evaluated.

INUNDATION REDUCTION BENEFITS

80. The major category of benefits identified and evaluated in the Pearl River Watershed study area is inundation (or cost) reduction benefits. These consist of flood damage reduction to existing development, associated personal properties, infrastructure, and associated administrative and operational costs incurred as a result of flooding.

81. Inundation reduction benefits were evaluated for six categories of urban flood damage in the Pearl River Watershed study area. These include flood damage reduction benefits to urban structures, automobiles, roads and bridges, and the treatment plant. Cost reduction benefits include the reduction in the costs associated with emergency operations and NFIP operating costs.

82. The HEC-FDA program integrated the results of the economic uncertainty analysis (elevation-damage curve with error) with the results of the hydrologic/hydraulic uncertainty analysis (stage-frequency curve with error) to produce the expected without- and with-project damages and the flood damage reduced. Project benefits are derived within HEC-FDA through internal program integration of a stage-damage curve, stage-discharge curve, and discharge-probability curve in which the program randomly samples flood events from all possible events. Without-project damages and project residual flood damages are calculated for each sampled event. The model keeps an account of each flood event and corresponding damages from the stage-damage curve. The model accounts for damages that would occur from these events with and without the implementation of the improvement plan. Also, each sampled flood event is evaluated internally for a levee height (i.e., levee plan of a given height at the gage), failure and nonfailure points, and other criteria. Residual damages occur for flood events that exceed the particular levee height.

83. Project benefits calculated within HEC-FDA are the result of the difference between without- and with-project damages. The model not only determines residual damages and benefits, but also determines the corresponding uncertainty. This uncertainty is derived from the uncertainty incorporated during the development of the stage-damage, stage-discharge, and discharge-probability relationships.

TOTAL PROJECT BENEFITS

84. Total project benefits, computed based on the difference in the without- and with-project expected annual damages, are presented in Table 6-8 for the Comprehensive Levee Plan and the LeFleur Lakes Plan. Flood reduction benefits to urban items were estimated to total $14.0 million with the implementation of the Comprehensive Levee Plan and $16.1 million with the implementation of the LeFleur Lakes Plan.

TABLE 6-8
SUMMARY OF ANNUAL BENEFITS

Benefit Category	Total Annual Benefits ($000) a/b/	
	Comprehensive Levee Plan	LeFleur Lakes Plan
Inundation (or Cost) Reduction Benefits		
Structures	11,099.0	12,989.2
Residential	4,288.6	4,790.4
Nonresidential	6,810.4	8,198.8
Automobiles	364.7	508.9
Emergency Costs	136.0	166.6
FIA Costs	440.5	481.9
Road and Bridge	85.8	50.8
Subtotal (excluding treatment plant)	12,125.8	14,197.4
Treatment Plant	1,855.0	1,855.0
TOTAL	13,980.8	16,052.4

a/ Values in 2006 dollars.
b/ Totals may not add to due rounding.

SECTION 9 – TOTAL PROJECT COSTS

FIRST COSTS

85. Construction first costs for the two plans evaluated in this analysis are presented the in Table 6-9. Estimated total first cost for the Comprehensive Levee Plan was estimated to be $205.8 million as compared to $1.4 billion for the LeFleur Lakes Plan (presented in September 2006 price levels). Included are Planning Engineering and Design and Construction Management costs, which are estimated based on costs from the engineering organizations for each technical component necessary for the construction and operation of the two alternatives. Detailed cost information is contained in the Engineering Appendix (Appendix 4).

TABLE 6-9
TOTAL PROJECT COSTS

Item	Comprehensive Levee Plan	LeFleur Lakes Plan
First Costs	205,765,000	1,428,777,000
Interest During Construction	12,175,000	93,409,000
Total Investment	217,940,000	1,522,186,000
Interest	10,625,000	74,207,000
Sinking Fund	1,084,000	7,569,000
Annual Operation and Maintenance	123,000	3,175,000
Total Annual Cost	11,832,000	84,951,000

a/ Costs were rounded to the nearest thousand and annualized using a 50-year economic project life, the current Federal interest rate of 4-7/8 percent, and 2006 price levels.
b/ Costs of the Levee Plan were annualized using a 4-year period of construction and a project completion date of 2013.
c/ Costs of the Lakes Plan were annualized using an 8-year period of construction and a project completion date of 2018.

TOTAL ANNUAL COSTS

86. Annual costs are also summarized in Table 6-9. Estimates of annual costs associated with the construction of the two alternative plans were based on an expected project economic life of 50 years and the current Federal discount rate of 4-7/8 percent. Interest and sinking fund costs reflect the estimated amortization costs. Costs for interest during construction, which

account for the cost of capital incurred during the construction period, are included in total investment costs. The estimated cost of operation and maintenance is based on previous annual cost expenditures for similar work for this region.

SECTION 10 - ECONOMIC JUSTIFICATION

THE STANDARD ECONOMIC ANALYSIS

87. Table 6-10 summarizes the results of the evaluation analyses for the Comprehensive Levee Plan and the LeFleur Lakes Plan. It includes a summary of the standard economic analyses—a comparison of costs, benefits, benefit-cost ratios, and excess benefits-over-cost.

TABLE 6-10
SUMMARY OF THE STANDARD ECONOMIC ANALYSIS

Item	Comprehensive Levee Plan	LeFleur Lakes Plan
Project Costs ($)		
First Cost	205,765,000	1,428,777,000
Interest During Construction	12,175,000	93,409,000
Total Investment	217,940,000	1,522,186,000
Interest	10,625,000	74,207,000
Sinking Fund	1,084,000	7,569,000
Annual Operation and Maintenance	123,000	3,175,000
Total Annual Cost a/	11,832,000	84,951,000
Project Benefits ($)		
Expected Annual Benefits	13,981,000	16,052,000
Excess Benefits	2,149,000	-68,899,000
Economic Results		
Benefit-Cost Ratio	1.18	0.19
Project Effectiveness	79%	91%

a/ Costs were rounded to the nearest thousand and annualized using a 50-year economic project life, the current Federal interest rate of 4-7/8 percent, and 2006 price levels.

SUMMARY OF THE BENEFIT-COST ANALYSIS

88. Based on the standard economic analysis, the Comprehensive Levee Plan is the only feasible alternative in this evaluation yielding a benefit-cost ratio greater than one. Also, with excess benefits-over-costs of $2.1 million and no net benefits for the Lakes Plan, the Levee Plan would qualify as the NED plan under Federal guidelines.

89. Nonetheless, although the LeFleur Lakes Plan is not feasible and has no excess benefits, it should be noted that it does afford a high degree of flood protection to the project area (91 percent). However, the costs of the Lakes Plan are significantly higher than the Levee Plan, and Federal guidelines prohibit Corps participation in a Federal project that is not economically justified (i.e., it must yield a benefit-cost ratio of 1.0 or greater). In other words, the Federal government needs to obtain a return of $1 for every dollar invested.

RESULTS OF THE STANDARD ECONOMIC ANALYSIS

90. The results of the final economic analysis for the Pearl River Watershed study are summarized in Table 6-10. The initial investment for this project would be approximately $217.9 million for the Comprehensive Levee Plan and $1.5 billion for the LeFleur Lakes Plan.

Annual benefits for the Comprehensive Levee Plan are estimated to be approximately $14.0 million and annual costs are $11.8 million, resulting in a benefit-cost ratio of 1.18 to 1. Annual benefits for the LeFleur Lakes Plan are estimated to be approximately $16.1 million as compared to an estimated annual cost of $85.0 million. This yields a benefit-cost ratio of 0.19 to 1 for the Lakes Plan.

91. The major difference in the outcome of the analysis is the cost. In a comparison of first costs, the Lakes Plan costs $1.2 billion more than the Levee Plan. In addition, there is a considerable difference in the operation and maintenance costs for the two plans--$3.2 million for the Lakes Plan and $123,000 for the Levee Plan. However, an analysis of project effectiveness shows the Lakes Plan to provide more flood protection.

PROJECT EFFECTIVENESS

92. Table 6-11 illustrates the project effectiveness in reducing without-project damages. The Comprehensive Levee Plan reduces without-project damages in the Pearl River Watershed study area by 79 percent while the LeFleur Lakes Plan provides a 91 percent degree of protection.

Excluding benefits from the treatment plant, both plans still provide a significant amount of protection with a 77 and 90 percent reduction in flood damages for the Levee Plan and Lakes Plan, respectively. The percent of flood damage reduction offered from each plan is presented in Table 6-12 by damage category.

TABLE 6-11
PROJECT EFFECTIVENESS
PERCENT REDUCTION IN FLOOD DAMAGES

River Stage at Gage	Total Without-Project Damage ($000) a/	Total With-Project Damage ($000) a/	Total Damage Reduced ($000) a/	Percent Damage Reduced (%)
Excluding Wastewater Treatment Plant Benefits				
Comprehensive Levee Plan	15,808.6	3,682.7	12,125.9	77
LeFleur Lakes Plan	15,808.6	1,611.2	14,197.4	90
Including Wastewater Treatment Plant Benefits				
Comprehensive Levee Plan	17,663.6	3,682.7	13,980..8	79
LeFleur Lakes Plan	17,663.6	1,611.2	16,052.4	91

a/ Presented in 2006 dollars.

TABLE 6-12
PERCENT FLOOD DAMAGE REDUCTION
BY DAMAGE CATEGORY

Benefit Category	Percent Flood Damage Reduction (%)	
	Comprehensive Levee Plan	LeFleur Lakes Plan
Structures	77	90
Residential	78	87
Nonresidential	73	87
Automobiles	64	89
Emergency Costs	74	91
FIA Costs	90	99
Roads and Bridges	97	57
Subtotal (excluding treatment plant)	77	90
Treatment Plant	100	100
TOTAL	79	91

SECTION 11 - SENSITIVITY ANALYSES

RELIABILITY OF EXPECTED PROJECT BENEFITS AND BENEFIT-COST RATIO

93. Reliability of the project benefits is one issue that can be addressed in risk and uncertainty analyses. Project analyses conducted within this framework yield expected mean flood benefits and the corresponding standard deviations which provide the analyst the statistical parameters to make inferences about the data. The expected mean, often called the average, is the most widely used measure of central tendency. The mean is the sum of a set of measurements divided by the number of measurements. The standard deviation is the measure of data variability. The standard deviation can be used for describing the variability of a set of measurements. Figure 6-2 illustrates the cumulative probability distribution and expected annual benefits for the Comprehensive Levee Plan. Figure 6-3 illustrates the cumulative probability distribution and expected annual benefits for the LeFleur Lakes Plan. The expected annual benefits of the Levee Plan and Lakes Plan are $14.0 and $16.1 million, respectively.

Figure 6-2
Expected Total Benefits
Comprehensive Levee Plan
Pearl River Watershed, Mississippi

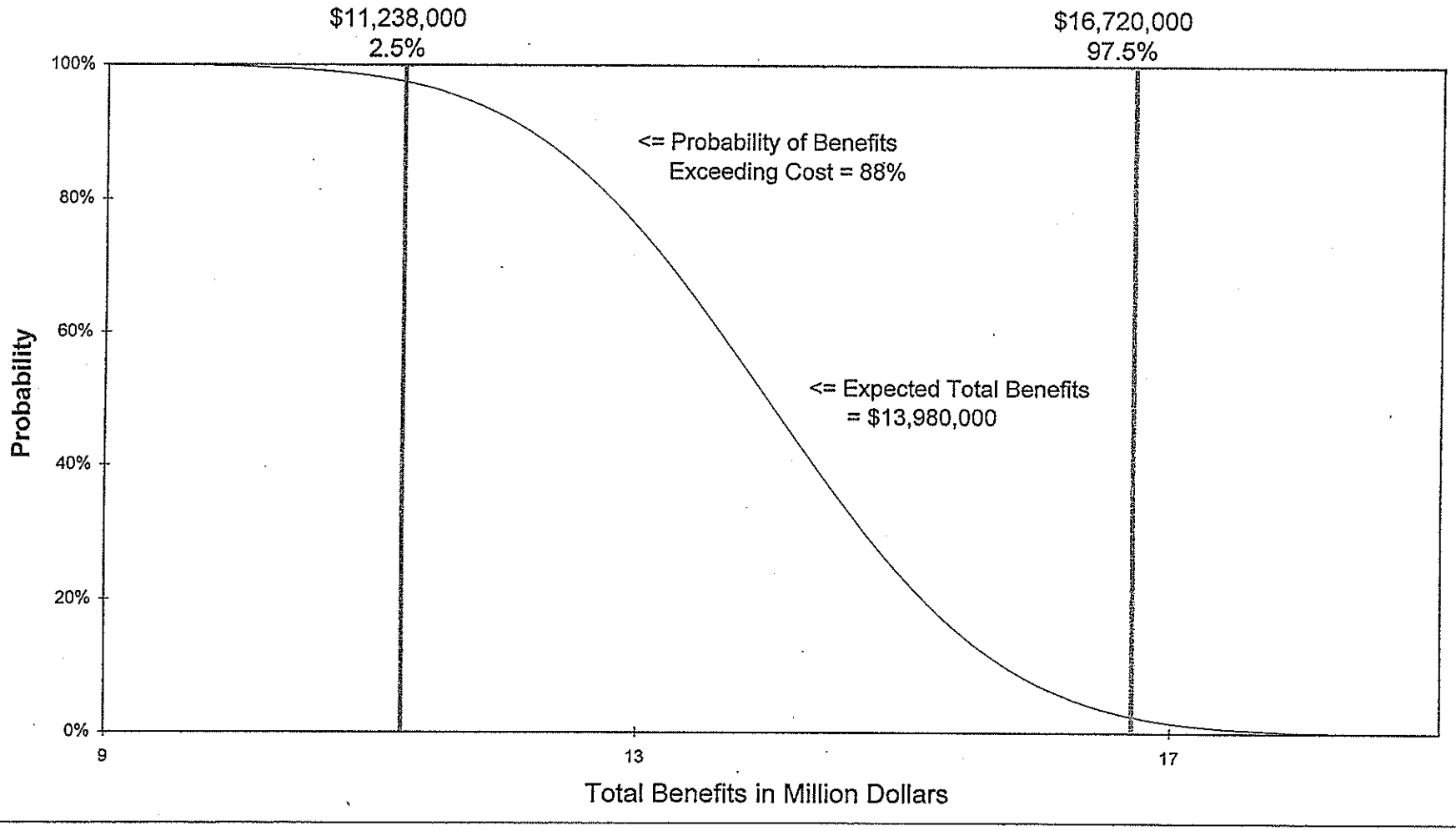
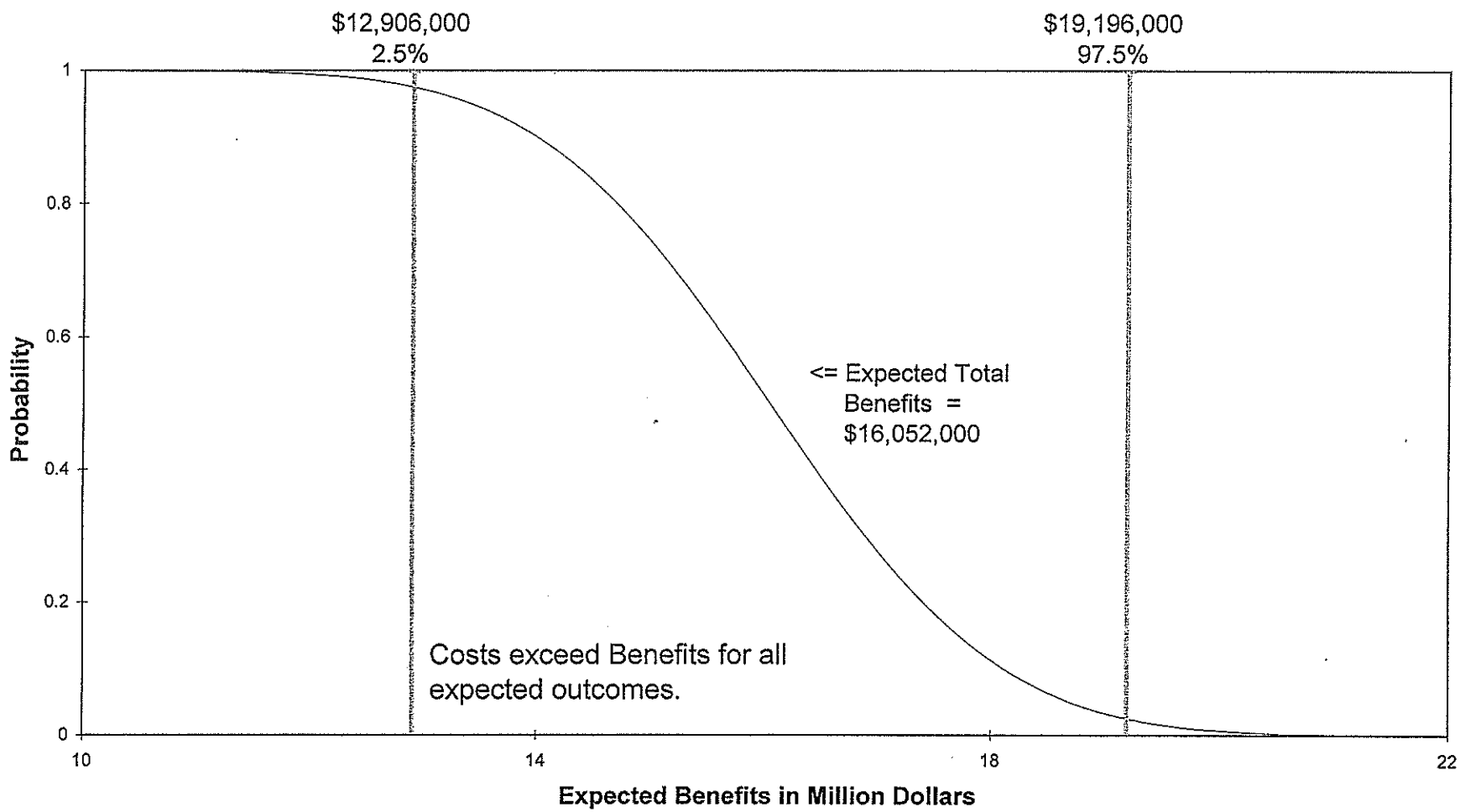


Figure 6-3
Expected Total Benefits
Lefleur Lakes Plan
Pearl River Watershed, Mississippi



94. Another attribute of evaluating a project with risk and uncertainty is the ability to determine the sensitivity of the project benefit-cost ratio (i.e., the probability that the benefit-ratio is greater than 1). This calculation illustrates how sensitive the project benefit-cost ratio is to the uncertainty inherent in the economic and hydrologic variables used to calculate flood damages. In risk analyses, the output probability distributions give a complete picture of all the possible outcomes. The probability distribution determines a "correct range" because the uncertainty associated with every input variable has been rigorously defined. Also, a probability distribution shows the relative likelihood of occurrence for each possible outcome. As a result, the process is no longer just comparing desirable outcomes with undesirable outcomes. Instead, it is recognized that some outcomes are more likely to occur than others and should be given more weight in the evaluation. This process has an advantage over traditional analyses because a probability distribution graphically displays the probabilities and gives a feel for the risk involved. Given the annual cost of the project, the probability of a given benefit-cost ratio can be determined by evaluating the benefit probabilities.

Expected Benefits

95. Figures 6-2 and 6-3 also display the selected plan benefits and corresponding probabilities within the risk and uncertainty framework for the Pearl River Watershed evaluation. To determine the total expected benefits, histogram functions for each reach and set of project

conditions were developed. Histograms are actually points along a graph calculated in the risk-based program to represent the output probability distributions of the expected benefits. These histogram functions were used to evaluate the uncertainty of the probability distributions for each reach and determine the benefits accrued based on the difference between without- and with-project conditions. Based on this analysis (using 100,000 iterations), there is an 88 percent probability that the combination of events for the Comprehensive Levee Plan would result in expected annual benefits greater than annual costs. For the LeFleur Lakes Plan, annual costs exceeded expected annual benefits for all possible scenarios.

Expected Benefit-Cost Ratio

96. The probabilities of possible benefit-cost ratios were determined by dividing the probable benefits by the annual costs for each flood control plan. The benefit-probability curve was thus converted to a benefit-cost ratio probability curve. Results of this evaluation indicate the Comprehensive Levee Plan to have an 88 percent probability that the combination of events would be a benefit-cost ratio greater than or equal to 1.0. On the other hand, all possible scenarios for the LeFleur Lakes Plan result in a benefit-cost ratio less than 1.0. Figures 6-4 and 6-5 display the expected benefit-cost ratio probabilities for the Levee Plan and Lakes Plan, respectively.

Figure 6-4
Probability of Expected Benefit-Cost Ratio
Comprehensive Levee Plan
Pearl River Watershed, Mississippi

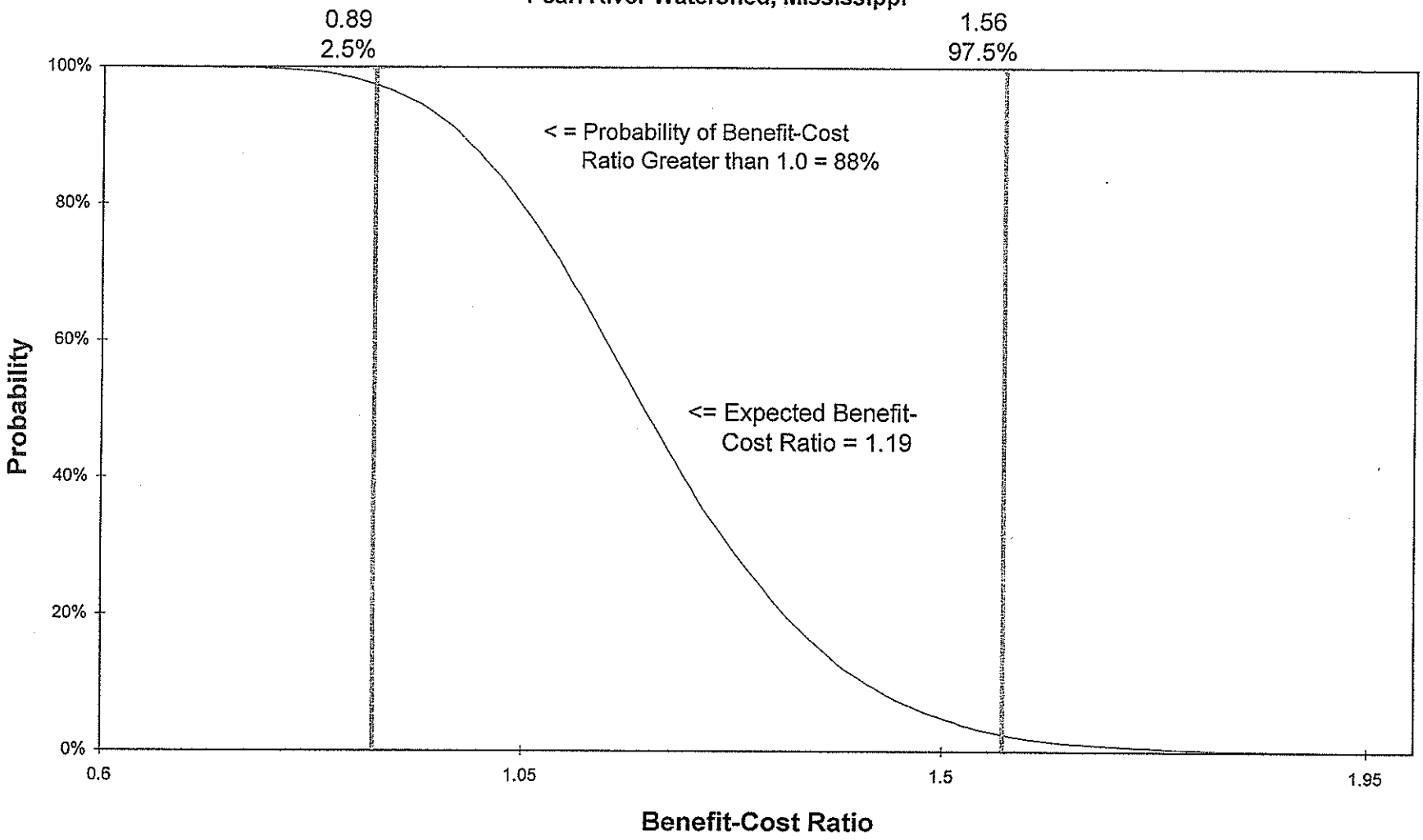
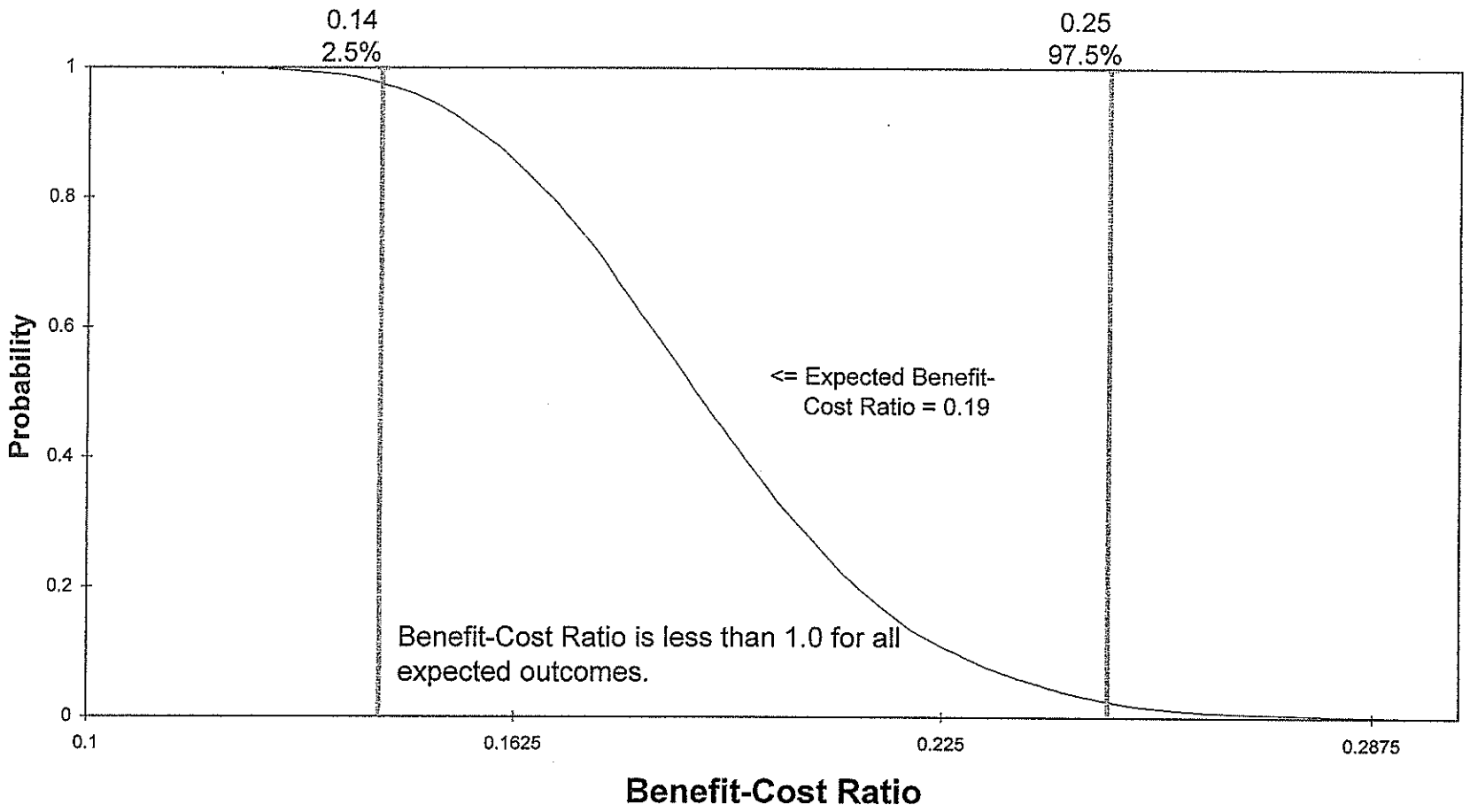
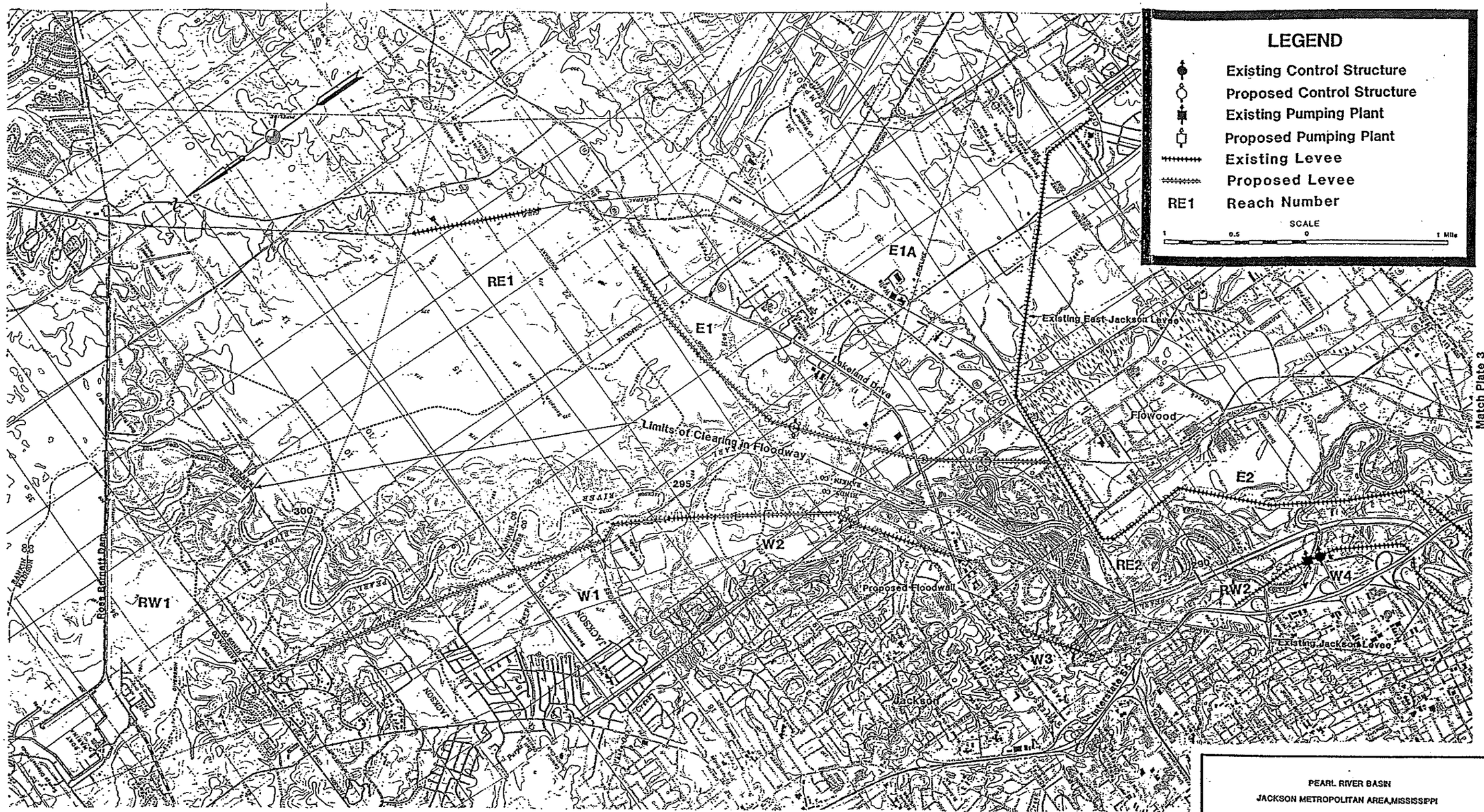


Figure 6-5
Probability of Expected Benefit-Cost Ratio
Lefleur Lakes Plan
Pearl River Watershed, Mississippi





PEARL RIVER BASIN

JACKSON METROPOLITAN AREA,MISSISSIPPI

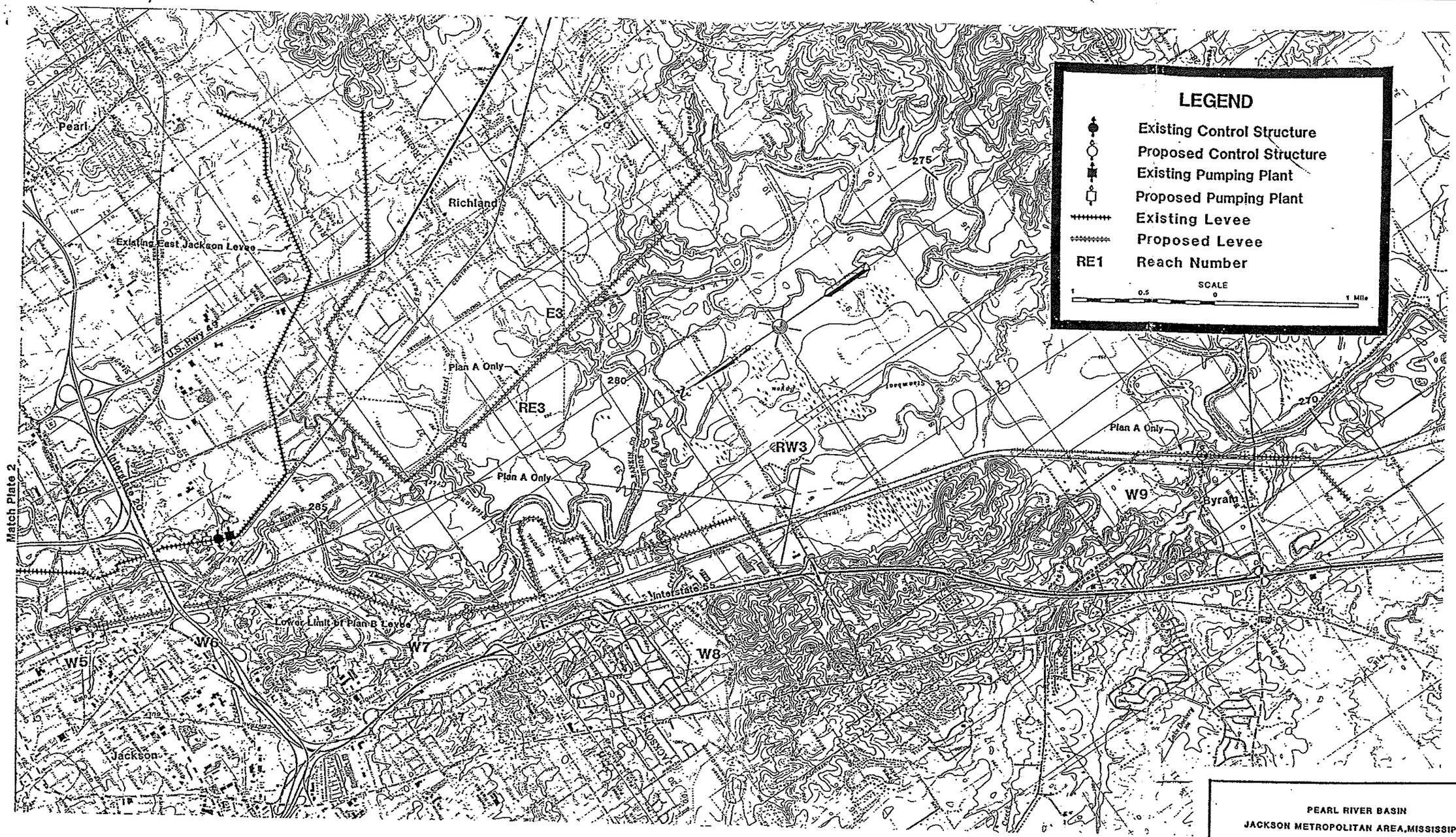
RECONNAISSANCE STUDY

COMPREHENSIVE LEVEE PLANS A&B

U.S. ARMY ENGINEER DISTRICK,VICKSBURG

CORPS OF ENGINEERS

PLATE 6-1



PEARL RIVER BASIN
JACKSON METROPOLITAN AREA, MISSISSIPPI
RECONNAISSANCE STUDY

COMPREHENSIVE LEVEE PLANS A&B

U.S. ARMY ENGINEER DISTRICT, VICKSBURG
CORPS OF ENGINEERS

PLATE 6-2

APPENDIX 7

AQUATIC RESOURCES

PEARL RIVER WATERSHED FEASIBILITY STUDY
TWO LAKES FLOOD CONTROL PLAN

AQUATIC EVALUATION

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April 18, 2006

Prepared for
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Abstract

The Corps of Engineers, Vicksburg District and the Rankin-Hinds Pearl River Flood and Drainage Control District are evaluating the feasibility of creating two contiguous lakes 16.5-miles long between Ross Barnett Dam and Byram, Mississippi. Fish-habitat data were collected in the study area during Summer 2005 and used to characterize baseline conditions and develop habitat models to determine project impacts. Two distinct habitats were evaluated: the Pearl River below Ross Barnett Dam and the upper reach of Ross Barnett Reservoir. This design was used to evaluate biological tradeoffs of converting the un-impounded section of the Pearl River to a series of 2 lakes for flood control and recreational purposes.

A total of 3377 individuals representing 44 species of fish were collected in the study area during summer 2005. Minnows (10 species) and sunfishes (8 species) were taxonomically dominant. Species richness was higher below the dam (37 species, all gears) than above (27 species, all gears). Riverine species were more abundant below the dam. Except for a few smallmouth buffalo captured above the dam, suckers were found exclusively below the dam. Other riverine species found only below the dam included paddlefish, silver chub, flathead catfish, white bass, and most darters. Sluggish flows in the river during summer and fall, primarily due to the pooling from the existing weir, provides adequate habitat for lacustrine species like sunfishes.

The Habitat Evaluation Procedure was used to calculate Habitat Units (HUs) for fish guilds based on habitat preference and tolerance to habitat changes. No adverse impacts were predicted for two guilds (Lacustrine, Wetland/Backwater guilds). Obligate and Facultative Riverine guilds will be adversely affected, as exemplified by a reduction in Suitability Index or Habitat Units. An HSI value of 0.04 for the proposed lake indicates that obligate riverine species will become rare or extirpated from the project area after construction is completed. Habitat Units for the Facultative Riverine guild actually increased post-project, but this was due to the increased water surface area of the lake, not increased habitat value. The lake HSI for facultative riverine species was more than 50% lower than for existing conditions.

Major biological tradeoffs are evident with riverine species declining and lacustrine species increasing. Four potential mitigation techniques can be considered to offset adverse impacts to Obligate and Facultative Riverine guilds: reconnecting secondary channels, reconnecting or managing water levels of backwaters, protection/creation of gravel bars, and construction of in-lake weirs to constrict flow and increase velocity.

Introduction

The Pearl River is 490 miles long, originating in east-central Mississippi, flowing southward through the impounded reach of Ross Barnett Reservoir, and eventually emptying into the Mississippi Sound in Louisiana. As part of the Pearl River Watershed Study, the Corps of Engineers, Vicksburg District and the Rankin-Hinds Pearl River Flood and Drainage Control District are evaluating the feasibility of creating two contiguous lakes 16.5-miles long between Ross Barnett Dam and Byram, Mississippi (Kilgore et al. 2004). The project will provide flood control and economic benefits for the Jackson metropolitan area.

Two weirs will be constructed forming an upper and lower lake. Water surface area will increase and swiftwater (riverine) habitats will be converted to slackwater (lacustrine) habitats. Water velocity may be detectible post-project, but values will be low (<0.3 ft/sec) compared to existing conditions (0.5 - >3 ft/sec). Impoundments adversely affect riverine fish communities (Cross et al. 1986; Cross and Moss 1987; Pflieger and Grace 1987). Riverine species adapted to high turbidity and widely fluctuating flows, such as suckers, riverine minnows, and darters, decline in abundance. However, lacustrine populations of pelagic planktivores, such as gizzard shad, and of sight-feeding carnivores, such as sunfishes (bluegill and largemouth bass), increase. This study evaluated biological tradeoffs of the project among disparate groups of fishes and recommends potential mitigation features that may offset adverse impacts to aquatic habitats.

Objectives

i) To describe baseline fish communities in the 16.5-mile un-impounded reach of the Pearl River below Ross Barnett reservoir,
ii) To document tradeoffs between fish communities characteristic of riverine and lacustrine habitats,
iii) To quantify effects of the project on fishes using the Habitat Evaluation Procedure

Methods

Sampling Sites

For analysis of riverine impacts, the study area encompassed two reaches above and below the reservoir. Reaches above the reservoir, in an upstream direction, were the lacustrine section of reservoir headwaters and riverine section before major pooling. These sites represent a gradient of pooled reaches, and were assumed to reflect habitat conditions similar to post-project conditions of the proposed Two-Lakes below the reservoir. Reaches below the reservoir included the tailwater of the reservoir spillway and pooled section above the low head weir. The lower most site was at the weir downstream of LeFleur's State Park boat ramp. Sampling these areas provided an opportunity to evaluate fish assemblages among disparate reaches and determine biological tradeoffs of converting the un-impounded section of the Pearl River below Ross Barnett Reservoir to lacustrine habitat.

Field Methods

Field collections occurred during two time periods: July and September 2005. Littoral (shoreline), pelagic (open water), and demersal (bottom) fishes were sampled concurrently. Littoral fishes were sampled with an 8 ft x 20 ft seine constructed of 3/16 – inch mesh. Five seine hauls, stratified among all apparent microhabitats, were taken at each station and pooled into a single composite sample. Pelagic fishes were collected with gill nets measuring 90 ft by 6 ft and constructed of six mesh panels ranging from ¾ to 2½ inches. Also, 2½-inch mesh trammel nets were deployed below the reservoir. Trotlines (200 ft long, 60 dropper lines spaced every 3 ft tied to 2/0 hooks) were used to sample benthic fishes. Lines were baited with worms, fished overnight along the bottom, and retrieved the following day; at least two trotlines were deployed at each sampling station. Boat-mounted electroshocking was occasionally used to collect fishes not susceptible to other capture methods or that occur in structurally-complex habitats. Large specimens collected were identified, measured, and released in the field. Small specimens, or large specimens of special interest, were deposited in collections at the Mississippi Museum of Natural Science (MMNS) and the University of Louisiana at Monroe, Museum of Zoology.

Physical habitat was measured concurrently with fish collections. Channel width was measured with a LASER or optical rangefinder. Water depth and velocity were measured at 10 approximately equidistant points along a cross-sectional transect using a stadia rod (< 6 feet) or boat-mounted depth finder (> 6 feet), and a Marsh-McBirney Flo-Mate water velocity meter. Submersed cover (large woody debris, submersed aquatic vegetation) was estimated qualitatively. Temperature, conductivity, dissolved oxygen, and pH were measured with a Hydrolab water quality probe, and turbidity with a Hach 2100P turbidimeter.

Data Analysis

Species were placed into ecological guilds, which are sets of species that exploit the same class of environmental resources in a similar way (Root 1967). Use of guilds allows fishes to be grouped according to common and relevant attributes and simplifies the evaluation process by creating a single robust variable (i.e., mean abundance of all species within that guild). Such a variable is sensitive to variation in the environmental resource of interest, but is relatively unbiased by seasonal variation in demography of any individual species (e.g., annual recruitment pulses, post-spawning mortality, local movements). Because the Project will convert the river into a reservoir, guilds were delineated according to three factors: water velocity preferences in relation to habitat preference (Leonard and Orth 1988; Aadland 1993), tolerance to change in physical habitat (Aadland 1993; Jester et al. 1992), and abundance of individual species.

Pearson correlation coefficients were calculated to identify habitat variables (water quality, stream hydraulics) correlated with guild abundance. Correlation matrices were used to help explain variation of guild abundance, and identify potential limiting habitat variables. Comparison of guild abundance among major habitat types (i.e., river, reservoir) were performed using Analysis of Variance, and if significant differences were detected, comparison of means was evaluated using the Student-Newman-Keuls (SNK) multiple range test. All statistical tests

were conducted using SAS.

Impact Analysis

Impacts of the project on fish guilds were calculated as the difference between post-project Habitat Units and pre-project Habitat Units using the following relationship:

Habitat Units = Habitat Suitability Index X Habitat Area

in which the Habitat Suitability Index (HSI) is a relative index of habitat quality and habitat area is the surface area of water in the river and reservoir.

Empirically based HSI models were developed based on mean abundance of guild members in the river and lake. For each guild, a HSI of 1.0 was designated for the habitat with the highest mean abundance and remaining habitats was scaled accordingly. HSI values ranged from 0 (no habitat value) to 1.0 (optimum habitat value), and were assigned to each guild for the river and proposed impoundment. HSI values were designated only for guilds whose mean abundance was significantly different among habitats. If no significant difference was detected based on the SNK test, HSI values were assumed to be equivalent among habitats and a default value of 1.0 was used for that guild. Pre- and post-project acres used to calculate HUs were provided by MVK using HEC-RAS, and represented conditions at average annual discharge (i.e., 4,700 cfs) The appropriate HSI value was multiplied by the corresponding acres to obtain Habitat Units.

Results and Discussion

Existing Habitat Conditions

The 16-mile reach of the Pearl River below Ross Barnett reservoir is mostly un-channelized and retains a sinuous channel with well-established point bars. However, two weirs impound the river at low water resulting in sluggish flows. Sand bars are present, but often mixed with depositional substrates (i.e., clay, mud). Sediment loads are minor, however, due to the controlling nature of Ross Barnett Dam. The river experiences substantial fluctuations in river stage, and shoaling and caving banks are evident. During our sampling period in summer 2005, low water prevailed and discharge averaged 624 cfs with water temperatures averaging 30 °C (Table 1). Average monthly discharge at the Jackson gage during July and September over the period of record is 1,453 and 693 cfs, respectively. The river below the reservoir was low in conductivity (79.2 μmhos/cm²), well-oxygenated (>6.0 mg/l), and clear (mean turbidity = 13 NTU) (Table 1). The river is relatively shallow (mean depth=5.4 ft) with low channel velocities (mean velocity=15 cm/sec). Instream structure was moderate along the banks in the form of trees, bushes, and fallen logs.

The upstream reaches above the reservoir, which was used as a reference for post-project conditions, had similar water quality conditions except temperature was slightly lower compared to the river (Table 1). The pool had a characteristic morphology of impounded waterbodies in river systems with width and depth gradually decreasing upstream. Average depth and width were 15 and 545 feet, respectively, which was substantially greater than the river. Slackwater conditions prevailed in the pool, with water velocity averaging only 2 cm/sec. Bottom substrates were mostly sand in the channel and channel border, and mud/silts or shifting sand in the littoral zone. Cattails (*Typha* spp.) occurred along the flats, and aquatic vegetation occurred sporadically in the littoral zone consisting of water hyacinth (*Eichhornia crassipes*), alligator weed (*Alternanthera philoxeroides*), and water primrose (*Ludwigia* spp.).

Fishes of the Pearl River

The ichthyofauna of the Pearl River System is diverse, containing 124 species of freshwater fishes (Davis 1970; Douglas 1975; Gunning and Suttkus 1991; Ross 2004) including numerous exploitable species (Holman 1988; Robinson and Rich 1988). The fish assemblage is dominated by minnows (27 spp), darters (22 spp), suckers and sunfishes (14 spp. each) (Appendix I). None of the species obtained during the study represent new geographic records for the Pearl River system.

A total of 3377 individuals representing 44 species of fish were collected in the study area during summer 2005 (Table 2). Like most Gulf Coast drainages, minnows (10 species) and sunfishes (8 species) were taxonomically dominant. Seines caught the most species, followed by electroshocking, gill nets, and trotlines. HSI models were developed from seining data because this technique was consistently used at all sites and usually provides the highest estimates of species richness per sample. Electroshocking was used infrequently, and did not capture species

that were not collected by other gear. Gill nets, and to a greater extent, trotlines, were more efficient in collecting larger, exploitable species including suckers and catfish.

There were obvious differences in species composition upstream and downstream of the dam. Species richness was higher below the dam (37 species, all gears) than above (27 species, all gears) (Table2). Riverine species were more abundant below the dam. Except for a few smallmouth buffalo captured above the dam, suckers were found exclusively below the dam. Other riverine species found only below the dam included paddlefish, silver chub, white bass, and most darters. One individual of the Gulf logperch was collected below the dam, and although not officially protected in Mississippi, is on the list of Freshwater Fish Species of Concern in Louisiana. Recreational fishes (e.g., largemouth bass and crappie) were infrequently collected, but appeared both upstream and downstream of the dam. Sluggish flows in the river during summer and fall, primarily due to the pooling from the existing weir, provides adequate habitat for lacustrine species like largemouth bass. Catfishes showed different conspecific patterns. Blue catfish, a species normally found in large rivers, was more abundant in the reservoir, whereas channel catfish was more abundant in the river. Flathead catfish was found exclusively in the river.

Ecological Guilds

Four ecological guilds of fishes were identified that represented all species collected by seining during the study (Table 3). Guilds were delineated according to water velocity preferences and tolerance or adaptation to changes in physical habitat. Water velocity is the primary habitat variable that will be influenced by construction of dams, and has been identified as one of the most suitable variables for identifying habitat guilds in stream studies (Leonard and Orth 1988; Aadland 1993). Habitat preference is also related to water velocity, and based on species accounts in Ross (2004), Robison and Buchanan (1988) and Pflieger (1995), fish species were grouped into riverine, lacustrine, and wetland/backwater habitats. Tolerance to habitat alteration is another primary factor to consider when identifying evaluation species. Species with low ranges of tolerance are inherently sensitive, or intolerant, of anthropogenic changes in habitat (Jester et al. 1992). Tolerance rankings were determined according to tolerance classifications published in Aadland (1993) and Jester et al. (1992). Considering habitat preference and tolerance together, four guilds were developed: Obligate Riverine, Facultative Riverine, Wetland/Backwater, and Lacustrine. Descriptions of the guilds are provided below:

Obligate Riverine Fishes – There are 6 species of minnows and darters in this guild that require flowing water habitat to complete one or more of their life stages. Guild abundance was positively correlated (i.e., Pearson correlation coefficient was statistically significant at $p<0.05$) with water velocity. All species in this guild are either intolerant or moderately intolerant of habitat changes, and are most susceptible to project impacts.

Facultative Riverine Species – There are 8 species in this guild, and most are classified as moderately tolerant or tolerant to habitat changes. These species are typically found in riverine environments, but can adapt to lacustrine conditions. Many are widespread and exploitable.

Guild abundance was not significantly correlated with habitat variables including water velocity.

Wetland/Backwater Species – Six wetland/backwater species were documented in the project area. Although guild abundance was not significantly correlated with habitat variables, these species are specially adapted to low water velocity and to periodic hypoxia and short-term (diel) fluctuations in temperature (Hoover and Killgore, 1998). This group was not specifically targeted in this study, and are likely more abundant than reported here. Wetland fishes are characteristic of southern bottomland hardwood river systems (Hoover and Killgore 1998).

Lacustrine Species - This guild is represented by 7 species and most are locally abundant, widely distributed, and all are tolerant or moderately tolerant of habitat changes. These species generally thrive in lakes and reservoirs. There were no significant correlations with water quality and habitat variables. However, species in this guild generally prefer low water velocities and are morphologically adapted to deeper, slower water of lakes and large pools of rivers.

Habitat Suitability Index

Mean abundance of obligate riverine fishes was significantly higher in the river than in Ross Barnett Reservoir (Table 4). A corresponding HSI=1.0 was assigned for the river, and due to the extremely low abundance of this guild in Ross Barnett reservoir, a HSI=0.04 was assigned for the proposed lake. Facultative riverine species were also significantly more abundant in the river, resulting in HSI values of 1.0 and 0.35 for the river and proposed lake, respectively. Wetland/Backwater species were more abundant in Ross Barnett Reservoir, but their abundance was not significantly different from the river. Likewise, mean abundance of Lacustrine species was not significantly different between the two habitats. For these guilds (i.e., Lacustrine and Wetland/Backwater guilds), we assumed an HSI=1.0 for existing and future conditions.

Impact Analysis

The acre values used to calculate HUs were 577 and 4,691 for existing and post-project conditions, respectively. HUs were calculated for those guilds with mean abundances significantly different between the Pearl River below Ross Barnett Dam and the upper reach of the reservoir (i.e., Obligate Riverine and Facultative Riverine guilds). We assumed no adverse impacts to guilds without significantly different mean abundances between habitats (i.e., Lacustrine and Wetlands/Backwater guilds). For these guilds, we assigned equivalent HSI values (i.e., HSI=1.0) for both habitats to reflect the assumption that changes in HUs are a direct result of acres, not value.

In terms of HSI values, Obligate and Facultative Riverine guilds will be adversely impacted (Table 5). Habitat Units for obligate riverine species decreased from 577 for the river to 188 for the lake. The increased surface area of the lake prevented a total loss of habitat. A HSI value of 0.04 for the proposed lake, however, indicates that obligate riverine species will become rare or extirpated from the project area after construction is completed. Therefore, the increase in acreage should not be considered a viable compensating mechanism for this guild, which represents

approximately 20% of the fish assemblage (Table 3).

Habitat Units for the Facultative Riverine guild actually increased post-project, but again, it was due to the increased water surface area of the lake. The lake HSI for facultative riverine species was more than 50% lower than for existing conditions. The lake may provide marginal habitat for this guild, and many are tolerant of anthropogenic changes, but the lake is not the preferred habitat for facultative riverine species. The impoundment will not totally curtail base flow (average post-project velocity=0.2 ft/sec, based on HEC-RAS, Ben Stubbs, MVK), which is comparable to velocities measured during this study at low flow conditions (0.5 ft/sec=15 cm/sec). However, according to HEC-RAS, average velocity at average annual discharge (4700 cfs) is usually over 2 ft/sec, substantially higher than post-project velocities. Depths will also increase from an exiting average of approximately 12 feet at average annual discharge to water ranging from 20-40 feet post-project (HEC-RAS, MVK). Reduction in littoral areas and backwaters post-project, and an increase in deeper, pelagic habitat may have further adverse impacts on riverine fishes.

Biological tradeoffs are evident with Lacustrine and Wetland/Backwater guilds increasing 2 to 7-fold, while obligate riverine species decline or become extirpated. This latter guild includes six minnows and darters species captured by seining, and larger species captured with other gears including paddlefish, highfin carpsucker, black buffalo, and blacktail redhorse. Construction of the lake will impede their movement, reduce habitat quality, and increase competition for food and space. Considering that the Pearl River systems harbors over 100 species, and we collected only 44 species, it is likely that additional obligate riverine species are occasionally present in the study area. However, additional seasonal sampling would be required to confirm the presence or absence of other obligate riverine species, including the endangered Gulf sturgeon.

The remaining guilds will benefit from the project, either because of increased habitat quality or surface area. The proposed lake will particularly benefit lacustrine species such as sunfishes, most of which are recreationally exploitable. Most facultative riverine species adapt to lacustrine conditions, and the Wetland/Backwater guild should expand in abundance and distribution from additional backwater and littoral areas formed during inundation. These analyses provide a quantitative basis to help make informed decisions, particularly relating to biological tradeoffs of different and distinct groups of fishes.

Mitigation

In-kind mitigation for loss of obligate riverine fish habitat is limited. Four potential mitigation techniques can be considered: reconnecting secondary channels, reconnecting or managing water levels of backwaters, protection/creation of gravel bars, and construction of in-lake weirs to constrict flow and increase velocity. Reconnecting secondary channels will directly benefit obligate riverine fishes by proving expanded areas of swiftwater habitat. Reconnecting or managing water levels in backwaters can have a direct or indirect benefit. Backwaters can be an important rearing area for juvenile fishes, and periodic connection to the river provides input of

organic material and nutrients, all of which benefits riverine species. Many obligate riverine species spawn on gravel bars. Therefore, another type of mitigation technique is to locate existing gravel bars in the Pearl River below the project area and develop management plans to protect or restore these habitats. Creation of gravel bars is another option to mitigate adverse impacts. A final option is to construct in-channel weirs within the impounded reach to constrict flows, increase velocity, and provide suitable habitat for riverine species.

For obligate riverine species, a 1:1 acre ratio is recommended since the post-project HSI for this guild was only 0.04. However, final mitigation credits for any of these techniques should be based on an interagency panel comprised of biologists familiar with the Pearl River system and fish fauna. Tradeoffs among guilds and the opportunities for in-kind mitigation will be important considerations for the final mitigation plan.

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Table 1. Mean water quality and hydraulic parameters measured in the Pearl River during July and September 2005 above and below Ross Barnett Reservoir.

Reach	Variable	N	Mean	Std Dev	Minimum	Maximum
Above Reservoir	Water temperature, °C	5	28.1	1.3	26.5	29.7
	Dissolved oxygen, mg/l	5	6.4	0.7	5.7	7.3
	Conductivity, µmhos/cm	5	58.8	1.9	56.0	61.0
	pH	5	6.2	0.6	5.5	6.7
	Turbidity, NTU	5	12.8	4.6	8.5	18.1
	Wetted width, ft	5	545.4	279.3	285.0	900.0
	Depth, ft	5	14.6	3.0	11.7	19.2
	Velocity, cm/sec	5	2.3	2.7	0.0	6.4
	Discharge, cfs	5	356.7	366.7	0.0	790.0
Below Reservoir	Water temperature, °C	11	30.5	1.2	28.8	32.9
	Dissolved oxygen, mg/l	10	6.7	0.7	6.0	7.8
	Conductivity, µmhos/cm	11	79.2	44.4	59.0	210.0
	pH	11	6.9	0.3	6.6	7.4
	Turbidity, NTU	11	12.6	3.2	6.1	19.8
	Wetted width, ft	11	197.5	89.3	51.0	324.0
	Depth, ft	11	5.4	2.6	0.9	10.3
	Velocity, cm/sec	11	15.1	11.8	0.0	32.7
	Discharge, cfs	11	623.9	431.1	0.0	1143.0

Table 2. Number of individual fish collected by species and gear above and below the Ross Barnett Reservoir for the Pearl River Two Lakes Project, Hinds, Rankin, Madison and Scott Counties, Mississippi in 2005. Gear types used were seine (above n=5, below n=11); gillnet (above n=9, below n=14); trotline (above n=6, below n=9); and electroshock boat (above n=6, below N/A).

Scientific name	Common name	Above Reservoir				Below Reservoir			Total
		Seine	Gillnet	Trotline	Electro-shock	Seine	Gillnet	Trotline	
Family Polyodontidae									
Polydon spathula	Paddlefish							1	1
Family Lepisosteidae									
Lepisosteus oculatus	Spotted gar				10		7		17
L. osseus	Longnose gar			2					2
Family Amiidae									
Amia calva	Bowfin						1		1
Family Clupeidae									
Dorosoma cepedianum	Gizzard shad	1	14		6	78			99
D. petenense	Threadfin shad				1	1			2
Family Esocidae									
Esox niger	Chain pickerel				1				1
Family Cyprinidae									
Cyprinus carpio	Common carp						8		8
C. venusta	Blacktail shiner	129				540			669
Hybognathus hayi	Cypress minnow					8			8
H. nuchalis	Mississippi silvery minnow	9				666			675
Macrhybopsis storeriana	Silver chub					4			4
Notropis atherinoides	Emerald shiner	1			1				2
N. longirostris	Longnose shiner	10				276			286

Table 2. Number of individual fish collected by species and gear above and below the Ross Barnett Reservoir for the Pearl River Two Lakes Project, Hinds, Rankin, Madison and Scott Counties, Mississippi in 2005. Gear types used were seine (above n=5, below n=11); gillnet (above n=9, below n=14); trotline (above n=6, below n=9); and electroshock boat (above n=6, below N/A).

Scientific name	Common name	Above Reservoir				Below Reservoir			Total
		Seine	Gillnet	Trotline	Electro-shock	Seine	Gillnet	Trotline	
N. texanus	Weed shiner	56			50	50			156
Pimephales notatus	Bluntnose minnow					13			13
P. vigilax	Bullhead minnow					19			19
Family Catostomidae									
Carpiodes carpio	River carpsucker		1						1
C. velifer	Highfin carpsucker						20		20
Ictiobus bubalus	Smallmouth buffalo				2		20		22
I. niger	Black buffalo						1		1
Moxostoma poecilurum	Blacktail redhorse						2		2
Family Ictaluridae									
Ictalurus furcatus	Blue catfish		27	57	3	2	12	19	120
I. punctatus	Channel catfish		5	5	3	23	13	11	60
Pylodictis olivaris	Flathead catfish		1				4	1	6
Family Fundulidae									
Fundulus notatus	Blackstripe topminnow	7				33			40
F. notti	Southern starhead topminnow	2							2
F. olivaceus	Blackspotted topminnow					2			2
Family Poeciliidae									
Gambusia affinis	Mosquitofish	15				52			67
Family Atherinidae									
Labidesthes sicculus	Brook silverside	32				509			541

Table 2. Number of individual fish collected by species and gear above and below the Ross Barnett Reservoir for the Pearl River Two Lakes Project, Hinds, Rankin, Madison and Scott Counties, Mississippi in 2005. Gear types used were seine (above n=5, below n=11); gillnet (above n=9, below n=14); trotline (above n=6, below n=9); and electroshock boat (above n=6, below N/A).

Scientific name	Common name	Above Reservoir				Below Reservoir			Total
		Seine	Gillnet	Trotline	Electro-shock	Seine	Gillnet	Trotline	
Family Moronidae									
Morone chrysops	White bass						1		1
Family Centrarchidae									
Lepomis humilis	Orangespotted sunfish					6			6
L. macrochirus	Bluegill	74			12	133	1		220
L. megalotis	Longear sunfish	15	1		10	82			108
L. microlophus	Redear sunfish	37			2	4			43
L. miniatus	Spotted sunfish	3							3
Micropterus punctulatus	Spotted bass	20			3	40	2		65
M. salmoides	Largemouth bass	4			4	37	1		46
Pomoxis annularis	White crappie		1		1				2
Family Percidae									
Ammocrypta beani	Naked sand darter					24			24
A. vivax	Scaly sand darter					2			2
Etheostoma gracile	Slough darter					1			1
Percina suttkusi	Gulf logperch					1			1
Family Sciaenidae									
Aplodinotus grunniens	Freshwater drum		2		1	1	4		8
Total Number of Species		16	8	3	16	27	15	4	44
Total Number of Individuals		415	52	64	110	2607	97	32	3377

Table 3. Fish species guild of the Pearl River below Ross Barnett Reservoir. Guild was based on species collected only by seining and used to develop HSI models. Species are grouped based on velocity preference, relative abundance, and tolerance ranking according to field data collected for this study, guidelines published in Aadland (1993) and Jester et al. (1992), and species accounts provided in Pflieger (1995), Robison and Buchanan (1988), and Ross (2004).

OBLIGATE RIVERINE SPECIES	WETLAND/BACKWATER SPECIES
Cypress minnow, *Hybognathus hayi*	Weed shiner, *Notropis texanus*
Mississippi silvery minnow, *Hybognathus nuchalis*	Blackstripe topminnow, *Fundulus notatus*
Silver chub, *Macrhybopsis storeriana*	Southern starhead topminnow, *F. notti*
Longnose shiner, *Notropis longirostris*	Blackspotted topminnow, *F. olivaceus*
Naked sand darter, *Ammocrypta beani*	Redspotted sunfish, *L. miniatus*
Scaly sand darter, *A.vivax*	Slough darter, *Etheostoma gracile*
Gulf logperch, *Percina suttkusi*	
FACULTATIVE RIVERINE SPECIES	**LACUSTRINE SPECIES**
Blue catfish, *Ictalurus furcatus*	Gizzard shad, *Dorosoma cepedianum*
Channel catfish, *I. punctatus*	Threadfin shad , *D. petenense*
Blacktail shiner, *Cyprinella venusta*	Western mosquitofish, *Gambusia affinis*
Emerald shiner, *Notropis atherinoides*	Orangespotted sunfish, *L. humilus*
Bluntnose minnow, *Pimephales notatus*	Bluegill, *L. macrochirus*
Bullhead minnow, *P.vigilax*	Redear, *L. microlophus*
Brook silverside, *Labidesthes sicculus*	Largemouth bass, *Micropterus salmoides*
Longear, *L. megalotis*	
Spotted bass, *Micropterus punctulatus*	
Freshwater drum, *Aplodinotus grunniens*	

Table 4. Mean abundance and Habitat Suitability Index (HSI) values of fish guilds for the existing river reach below Ross Barnett Reservoir and the proposed lake based on collections made in the upper reach of Ross Barnett reservoir. Abundance is the number of fish collected per 5 seine hauls. An asterisk indicates that mean value for a guild was significantly greater among habitats based on Student-Newmans-Keuls Multiple Range Test at $p<0.1$. Only mean abundances that were significantly different were assigned an HSI value. Those that were not significantly different were assumed to have the same HSI value (HSI=1).

Guild	River (n=11)		Lake (n=5)	
	Mean ±SD	HSI	Mean±SD	HSI
Obligate Riverine	89.4±79.7*	1.0	3.8±8.5	0.04
Facultative Riverine	111.5±82.7*	1.0	39.4±51.5	0.35
Lacustrine	28.3±43.3	1.0	26.4±27.7	1.0
Wetland/Backwater	7.8±9.3	1.0	13.6±23.4	1.0

Table 5. Habitat Units of fish guilds for existing conditions of the 16.5- mile reach of the Pearl River below Ross Barnett Dam, and for the same reach after completion of the Two Lakes project.

Guild	Existing Conditions			Post-Project Conditions			Percent Change in HUs
	Acres	HSI	HU	Acres	HSI	HU	
Obligate Riverine	577	1.0	577	4730	0.04	189	-67
Facultative Riverine	577	1.0	577	4730	0.35	1655	+187
Lacustrine and Wetlands/Backwater	577	1.0	577	4730	1.0	4730	+720

APPENDIX I: FRESHWATER FISHES OF THE PEARL RIVER DRAINAGE

	PETROMYZONITIDAE	
1.	*Lampetra aepyptera*	Least brook lamprey
2.	*Ichthyomyzon cataneus*	Chestnut lamprey
3.	*Ichthyomyzon gagei*	Southern brook lamprey
	ACIPENSERIDAE	
4.	*Acipenser oxyrhynchus desotoi*	Gulf sturgeon
	POLYODONTIDAE	
5.	*Polyodon spathula*	Paddlefish
	LEPISOSTEIDAE	
6.	*Atractosteus spatula*	Alligator gar
7.	*Lepisosteus oculatus*	Spotted gar
8.	*Lepisosteus osseus*	Longnose gar
9.	*Lepisosteus platostomus*	Shortnose gar
	AMIIDAE	
10.	*Amia calva*	Bowfin
	HIODONTIDAE	
11.	*Hiodon tergisus*	Mooneye
	ANGUILLIDAE	
12.	*Anguilla rostrata*	American eel
	CLUPEIDAE	
13	*Alosa alabamae*	Alabama shad
14.	*Alosa chrysochloris*	Skipjack herring
15.	*Dorosoma cepedianum*	Gizzard shad
16.	*Dorosoma petenense*	Threadfin shad
	CYPRINIDAE	
17.	*Carassius auratus*	Goldfish
18.	*Cypinus carpio*	Common carp
19.	*Cyprinella camura*	Bluntface shiner
20.	*Cyprinella venusta*	Blacktail shiner
21.	*Hybognathus hayi*	Cypress minnow
22.	*Hybognathus nuchalis*	Mississippi silvery minnow
23.	*Luxilus chrysocephalus*	Striped shiner
24.	*Lythrurus roseipinnis*	Cherryfin shiner
25.	*Macrhybopsis aestivalis*	Speckled chub
26.	*Macrohybopsis storeriana*	Silver chub
27.	*Nocomis leptocephalus*	Bluehead chub
28.	*Notemigonus crysoleucas*	Golden shiner
29.	*Notropis atherinoides*	Emerald shiner
30.	*Notropis buccata*	Silverjaw minnow
31.	*Notropis chalybaeus*	Ironcolor shiner
32.	*Notropis longirostris*	Longnose shiner
33.	*Notropis maculatus*	Taillight shiner
34.	*Notropis shumardi*	Silverband shiner
35.	*Notropis signipinnis*	Flagfin shiner
36.	*Notropis texanus*	Weed shiner
37.	*Notropis volucellus*	Mimic shiner
38.	*Notopis welaka*	Bluenose shiner

APPENDIX I (CON'T)

CYPRINIDAE (CON'T)

39.	*Notropsi winchelli*	Clear chub
40.	*Opsopoeodus emiliae*	Pugnose minnow
41.	*Pimephales notatus*	Bluntnose minnow
42.	*Pimephales vigilax*	Bullhead minnow
43.	*Semotilus atromaculatus*	Creek chub

CATOSTOMIDAE

44.	*Carpiodes carpio*	River carpsucker
45.	*Carpiodes cyprinus*	Quillback
46.	*Carpiodes velifer*	Highfin carpsucker
47.	*Cycleptus elongatus*	Blue sucker
48.	*Erimyzon oblongus*	Creek chubsucker
49.	*Erimyzon sucetta*	Lake chubsucker
50.	*Erimyzon tenuis*	Sharpfin chubsucker
51.	*Hypentelium nigricans*	Northern hog sucker
52.	*Ictiobus bubalus*	Smallmouth buffalo
53.	*Ictiobus cyprinellus*	Bigmouth buffalo
54.	*Ictiobus niger*	Black buffalo
55.	*Minytrema melanops*	Spotted sucker
56.	*Moxostoma carinatum*	River redhorse
57.	*Moxostoma poecilurum*	Blacktail redhorse

ICTALURIDAE

58.	*Ameiurus melas*	Black bullhead
59.	*Ameiurus natalis*	Yellow bullhead
60.	*Ictalurus furcatus*	Blue catfish
61.	*Ictalurus punctatus*	Channel catfish
62.	*Noturus funebris*	Black madtom
63.	*Noturus gyrinus*	Tadpole madtom
64.	*Noturus leptacanthus*	Speckled madtom
65.	*Noturus munitus*	Frecklebelly madtom
66.	*Noturus miurus*	Brindled madtom
67.	*Noturus nocturnus*	Freckled madtom
68.	*Pylodictis olivaris*	Flathead catfish

ESOCIDAE

69.	*Esox americanus*	Redfin pickerel
70.	*Esox niger*	Chain pickerel

APHREDODERIDAE

71.	*Aphredoderus sayanus*	Pirate perch

FUNDULIDAE

72.	*Fundulus catenatus*	Northern studfish
73.	*Fundulus chyrysotus*	Golden topminnow
74.	*Fundulus dispar*	Northern topminnow
75.	*Fundulus notatus*	Blackstripe topminnow
76.	*Fundulus notti*	Starhead topminnow
77.	*Fundulus olivaceus*	Blackspotted topminnow

APPENDIX I (CON'T)

	POECILIIDAE	
78.	*Gambusia affinis*	Mosquitofish
79.	*Heterandria formosa*	Least Killifish
80.	*Poecilia latipinna*	Sailfin molly
	ATHERINIDAE	
81.	*Labidesthes sicculus*	Brook silverside
82.	*Menidia beryllina*	Inland silverside
	MORONIDAE	
83.	*Morone chrysops*	White bass
84.	*Morone mississippiensis*	Yellow bass
85.	*Morone saxatilis*	Striped bass
	CENTRARCHIDAE	
86.	*Ambloplites ariommus*	Shadow bass
87.	*Centrarchus macropterus*	Flier
88.	*Lepomis cyanellus*	Green sunfish
89.	*Lepomis gulosus*	Warmouth
90.	*Lepomis humilis*	Orangespotted sunfish
91.	*Lepomis macrochirus*	Bluegill
92.	*Lepomis marginatus*	Dollar sunfish
93.	*Lepomis megalotis*	Longear sunfish
94.	*Lepomis microlophus*	Redear sunfish
95.	*Lepomis punctatus*	Spotted sunfish
96.	*Lepomis symmetricus*	Bantam sunfish
97.	*Micropterus punctulatus*	Spotted bass
98.	*Micropterus salmoides*	Largemouth bass
99.	*Pomoxis annularis*	White crappie
100.	*Pomoxis nigromaculatus*	Black crappie
	ELASSOMATIDAE	
101.	*Elassoma zonatum*	Banded pygmy sunfish
	PERCIDAE	
102.	*Crystallaria asprella*	Crystal darter
103.	*Ammocrypta beani*	Naked sand darter
104.	*Ammocrypta vivax*	Scaly sand darter
105.	*Etheostoma chlorosomum*	Bluntnose darter
106.	*Etheostoma fusiforme*	Swamp darter
107.	*Etheostoma gracile*	Slough darter
108.	*Etheostoma histrio*	Harlequin darter
109	*Etheostoma lynceum*	Brighteye darter
110.	*Etheostoma parvipinne*	Goldstripe darter
111.	*Etheostoma proeliare*	Cypress darter
112.	*Etheostoma stigmaeum*	Speckled darter
113.	*Etheostoma swaini*	Gulf darter
114.	*Etheostoma whipplei*	Redfin darter
115.	*Percina aurora*	Pearl darter
116.	*Percina lenticula*	Freckled darter
117.	*Percina maculata*	Blackside darter
118.	*Percina nigrofasciata*	Blackbanded darter
119.	*Percina sciera*	Dusky darter

120. *Percina shumardi* River darter

APPENDIX I (CON'T)

PERCIDAE (con't)

121. *Percina sp.* Gulf Logperch
122. *Percina vigil* Saddleback darter
123. *Stizostedion vitreum* Walleye

SCIAENIDAE
124. *Aplodinotus grunniens* Freshwater drum